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CURRICULUM CONSTRUCTION

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PHONIC ABILITY AS RELATED TO CERTAIN ASPECTS OF READING AT THE COLLEGE LEVEL[1]

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I. INTRODUCTION

Anderson and Fairbanks[2] have found that poor readers are relatively deficient in their reading vocabulary. Moreover, words without meaning when seen are recognized when pronounced by someone else. This, of course, is characteristic of children before they become adept in independent word analysis or before they build up a large sight vocabulary. Young[3] and Russell[4] also have shown that pupils in or below fifth grade are generally superior in comprehending ideas read to them compared with their own reading of the same material. As soon as children master the mechanics of word recognition or phonics[5] and broaden their reading experience, however, their reading vocabulary and comprehension approach and may even go beyond their hearing vocabulary and comprehension.

From a developmental point of view, poor readers in college have remained in an elementary stage of reading in which many words are more easily recognized when presented auditorially than when presented visually. It seems reasonable that instruction in phonics may prove useful on the college level, as well as on the elementary level, in improving the reading vocabulary of these students.

Studies have provided evidence that poor readers make many mistakes when they read orally. Swanson[6] found many perception inaccuracies and gross mispronunciations when he analyzed the oral reading errors of college freshmen who were poor readers. But he did not relate these errors to meaning. If the errors are coincident with lack of comprehension, this may be considered one more indication that phonic training might be a valid means of improving vocabulary at the college level.

The purpose of the present experiment is to determine the relationship between mispronunciations and comprehension and to determine the effect of training in phonics upon certain aspects of reading.

II. EXPERIMENTAL PROCEDURE

Subjects

The student personnel for this study was 72 poor silent readers from the freshman class who ranked at the 20th percentile or below on the *Iowa Silent Reading Test* in the *University of Iowa Qualifying Examinations* when they entered the university. Half of these served as an experimental group in total comprehension on the *Iowa Silent Reading Test* and in general ability as measured by the composite qualifying score on the above examinations.[7] The latter group served as a control group and was not given special training in phonics.

The students were referred to the reading clinic by the offices of the dean of men and the dean of women. The nature and purpose of the clinic were explained to them and they were given an opportunity to decide whether or not they wished to enroll. Those inter-

[1] A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, in the Department of Psychology, in the Graduate College of the State University of Iowa. This research was done under the direction of Dr. Joseph Tiffin, Professor of Psychology, Purdue University.

[2] Anderson, I. H. and Fairbanks, G. "Common and Differential Factors in Reading Vocabulary and Hearing Vocabulary," *Journal of Educational Research* XXX, (January, 1937), pp. 317–324.

[3] Young, W. E. The Relation of Reading Comprehension and Retention to Hearing Comprehension and Retention, (Thesis) University of Iowa, Iowa City, Iowa, 1934.

[4] Russell, R. D. The Relative Effectiveness of Presenting Verbal Material Visually and Orally as Measured by the Amount of Recall, (Thesis) University of Iowa, Iowa City, Iowa, 1923.

[5] As used here phonics involves teaching the child the sound of the letters and their combinations and how to blend the sounds into syllables and words. By 'sounding out' a word, the child may recognize it as a word he already knows.

[6] Swanson, D. E. "Common Elements in Silent and Oral Reading," *Psychological Monographs*, XLVIII (November, 1937), 61–69.

[7] This examination has been shown to correlate .85 with the *Otis Self-Administering Intelligence Examination*, which is as high as the correlations between most standardized intelligence tests. Feder, D. D. *Suggestions for Testing Programs at the College Level* (pamphlet). University of Iowa, Bureau of Educational Research, Iowa City, Iowa.

ested in attending were given the series of tests cited in this report. A period of training in phonics then followed. This varied according to the needs of the individual. Some individuals did not even know the vowel or consonant sounds and required a longer training period than others who already knew most of the individual sounds.[8] The method of teaching phonics was based on that of Cordts[9] with adaptations for the college level. In using the list of words, the clinician usually followed the procedure of picking out some of the easier words in a particular group, such as the suffix group 'tious'. He would then tell each student to pronounce them and ask him if he could see something common to all of them or if he knew how the particular combination being studied was pronounced, or if he could tell what principle governed all of the words. After this the less familiar words in the particular group were attacked. This material was kept on file in the clinic. None of the words used as examples in training was to be found in the tests, and during training attention was given only to pronunciation of words. Meanings were not considered. When an individual had completed training, his paired control was called in; they were given the final series of tests within a few days of each other. Practical considerations made it advisable to give only the *Nelson-Denny* vocabulary, spelling and pronunciation tests to the control group in the second series. Phonic ability thus was the only skill not retested in the control group, since it seemed least likely to improve through maturation. An average of 16 conferences was held with each student in the experimental group.

Tests Administered

The following tests were administered to both the experimental and control groups at the beginning of training and also after training: (1) *Nelson-Denny Reading Test*, Form B, consisting of two parts, 100 vocabulary words and paragraph comprehension. Although there is a time limit of 10 minutes on the vocabulary test, no time was imposed because speed was not the important factor and responses on the same number of items before and after training were desirable. The time limit of 20 minutes was increased to 30 in the paragraph comprehension test in order to increase its reliability for poor readers; (2) The *Inglis Vocabulary Test*[10] (150 words); (3) a spelling test, consisting of the spelling sections of both forms of the *Iowa English Training Test* (125 words); (4) a phonic ability test constructed by the writer (see the Appendix); (5) pronunciation of the vocabulary words in the *Nelson-Denny Test* and *Inglis English Vocabulary Test;* (6) an oral reading test, composed of four paragraphs of about 200 words each from the *Nelson-Denny Reading Test,* Form A.

Construction of the Phonic Ability Test

Some measurement of the phonic knowledge possessed by the students was necessary as part of the diagnostic clinical program; to meet this need a phonic ability test was constructed. Part I tests syllabification, Part II tests knowledge of the various principles of pronunciation. Most of the test had to be carried out through nonsense words because use of real words known by sight would not have necessitated students using a knowledge of phonics in working out their pronunciation. However, the last 40 words of Part I contained words which were selected from the vocabulary section of the *Iowa Silent Reading Test.* Each item in Part II was constructed to measure only one thing. For example, the first item, 'histen', was designed to measure the student's knowledge of the fact that the t in words ending in 'sten' is silent. The third item, 'pnum', determines whether or not a student knows that p before n in the same syllable is silent. The test in its preliminary form was given to 45 students in a summer school class largely made up of graduate students in education. Certain items were discarded and revised when an item analysis was made of those results. The test then was given to freshmen from the academic year 1936–37 chosen at random from the freshman speech classes of the University of Iowa. The final test results are based on these students together with the control and experimental groups of poor readers.

III. Results

Relationship Between Mispronunciation and Inaccurate Comprehension

One phase of the study attempts to answer the question: Does a mispronunciation indi-

[8] The material used in teaching can be found in appendix, along with a copy of the phonic ability test.

[9] Cordts, A. D. *The Word Method of Teaching Phonics.* Chicago: Ginn and Company, 1929.

[10] Inglis, A. "A Vocabulary Test for High-School and College Students," *The English Leaflet,* XXIII, 1923, No. 197.

TABLE I

EXAMPLES OF EACH TYPE OF ERROR*

Error type	Word	Student's pronunciation
Omission of sound	suave	säv
Insertion of sound	accountant	u-kou'-tun-unt
Substitution of sound	invidious	in-vi'-joo-us
Slight change of word	abandoned	abandon
Substitution of word	resorts	restores
Faulty accent	probity	pro-bi'ti
Faulty accent necessitated by other errors	mephitic	mef'-ik
Faulty vowel	toadies	tä'-dez
Faulty consonant	pungent	pun'-junt
Reversal of sounds	protuberance	per-too'-bur-uns
Words containing 1 error	hiatus	hā'-tus
Words containing 2 errors	solicitous	so-lit'-eus
Words containing 3 or more errors	vacillated	vu-sil'-ē-ā-tud

* Dash over vowel indicates long sound; no mark indicates short sound.

cate lack of comprehension of the meaning of the word, and if so, is any certain type of mispronunciation specifically indicative of inaccurate or no comprehension?

Each pronunciation record for each word was analyzed as to the type of error it contained. Errors were classified in several categories: omission of a sound, addition of a sound, substitution of a syllable, substitution of a word, reversal of a sound, faulty accent, faulty accent necessitated by another error, faulty vowel sound necessitated by another error, faulty consonant, repetition of a sound, repetition of a word, no attempt at a word, words containing one error, two errors, and three errors respectively. In Table I are shown examples of each type of error.

These errors were then classified as to whether or not they were accompanied by correct or incorrect comprehension. These results are found in Table II. The reader will note that most of the percentages for lack of comprehension range between 75 and 85. On the average, 78 per cent of the words which were mispronounced also were missed in meaning, although the presence in the test of well-known words which are regionally mispronounced, such as 'miniature' which we hear as 'minucher' makes this percentage lower than it would otherwise be. Although these percentages are high, there is no inference that all of the 78 per cent would be recognized by hearing the word pronounced. Many of the words still would have been unfamiliar if the students had themselves pronounced the words correctly. Some of the words, however, would have been recognized and associated with their correct meanings. It is in this latter group of words that phonic training may be most helpful.

TABLE II

PERCENTAGE OF MISPRONUNCIATIONS ACCOMPANIED BY WRONG COMPREHENSION

Error type	Nelson Denny	Inglis	Both tests
	%	%	%
Omission of sound	73	76	74
Addition of sound	78	77	77
Substitution of sound (syllable)	78	81	80
Substitution of different word	84	64	73
Slight change of word	64	61	63
Faulty accent	79	78	78
Faulty accent necessitated by other errors	79	86	83
Total faulty accents	79	82	81
Faulty vowel sound	82	80	81
Faulty vowel sound necessitated by other errors	80	79	79
Total faulty vowels	81	80	80
Wrong consonant sound	81	77	79
Reversals of sounds	76	84	80
No attempt	90	93	91
Words containing 1 error	74	77	76
Words containing 2 errors	79	82	81
Words containing 3 or more errors	81	82	82
Correction of syllable	57	55	56
Correction of word	66	53	60
Average	79	78	78

There seems to be a relationship between the extent of the mispronunciation and probability of missing the meaning of a word. A slight change such as perceiving 'adolescence' for 'adolescent' was accompanied by a failure in comprehension only 63 per cent of

the time, while the substitutions of entirely different words were accompanied by lack of comprehension 73 per cent of the time and no attempt 91 per cent of the time. There is also a larger percentage of 3-error words not comprehended than there are words with a single error. With the exception of substitutions of different words the size of the percentages are quite consistent from the *Nelson-Denny* list to the *Inglis* list. The *Nelson-Denny* list evidently contained more words which closely resembled other words than the *Inglis* test. This consistency would seem to indicate that the relationship is independent of the test used.

Reliability of Recording

When *E's* personal recording was compared with phonographic recording, the agreement was very high (*cf.* Table III). The average per cent of agreement for oral reading is 97 and for mispronunciation 98. Faulty accents, insertions, and omissions in oral reading showed the least agreement, and these were 93 and 94 per cent. Some of the disagreements seemed to be due not to personal recording but to phonographic recording. If a single unaccented sound was omitted or inserted or a vowel slightly changed, it frequently was very hard to distinguish this change on a phonograph record. The fact that one can become skilled in the recording of oral reading and pronunciation is significant clinically. An objective record of oral reading can be secured without the expense or other difficulties which the use of a phonographic recording technique involves.

TABLE III

RELIABILITY OF PERSONAL RECORDING

Per cent agreement of personal with phonographic recording

Type of error	Oral reading No. of errors = 2123	Pronunciation No. of errors = 640
No attempt	100	100
Reversals	100	100
Corrections	98	100
Repetitions	98	98
Faulty consonants	97	97
Substitutions	97	100
Faulty vowels	96	97
Insertions	93	100
Omissions	94	97
Wrong accent	93	95
Average	97	98

Evaluation of the Phonic Ability Test

The reliability of the phonic ability test was computed by correlating the odd items against the even items for each part and applying the Spearman–Brown formula for estimating reliability for the whole test. For Part I, which measures ability to break words down into syllables, the estimated coefficient is .94 and for Part II, which requires the student to correct pronunciations, the coefficient is .88. Both of these are high enough to indicate that the test is reliable for individual diagnosis.

Some aspects of validity of the test have been determined by statistical relationships with other tests and by its part-whole correlations. Part II correlates .69 with the *Iowa Silent Reading Test* but Part I has a much lower correlation, .40. Since Part I is composed of more items, its weight serves to pull down the correlation of the total test with reading comprehension. If lack of time necessitated the use of only one part, it probably would be better to use Part II. Part II also correlates highly with mispronunciation. These correlations might have been even higher if a wider range of ability could have been included. Pronunciation records were available, however, on only the poor readers who had been in the reading clinic. The fact that the test correlates more highly with the *Iowa Silent Reading Test* and the number of mispronunciations than it does with *Mathematics Aptitude*[11] shows that it is not a measure of general ability but is more specifically a measure of one aspect of reading ability. One might ask why a measure of phonic ability would be necessary if it correlates as high as .70 with general reading ability. Justification can be made, however, by analogy. The coefficients of correlation between reading and intelligence tests are sometimes this high but one does not use intelligence tests as an index to reading ability. The correlation between phonic ability and general reading ability is not so high but that there are some cases who are poor readers but rate high in the mechanics of reading. These cases should not be given training in phonics. The fairly low inter-part but high part-whole correlations meet one of the criteria of the validity. They show that Part I

[11] This is also given in the *University of Iowa Qualifying Examinations*. It is the best single measure of intelligence in the battery of tests.

TABLE IV

CORRELATIONS OF PHONIC ABILITY TEST SCORES WITH OTHER TEST SCORES

Part I odd with even items	.94
Part II odd with even items	.88
N = 179	
Part I with Iowa Silent Reading Test	.40
Part II with Iowa Silent Reading Test	.69
Total with Iowa Silent Reading Test	.45
N = 179	
Number of mispronunciations on Nelson-Denny test	
with Part I	.38
with Part II	.62
with Total	.62
N = 80	
Number of mispronunciations on Inglis test	
with Part I	.31
with Part II	.62
with Total	.52
N = 80	
Part I with Mathematics aptitude	.21
Part II with Mathematics aptitude	.17
Total with Mathematics aptitude	.30
N = 179	
Part I with Part II	.51
Part I with Total	.84
Part II with Total	.92
N = 179	

and Part II do not measure the same functions.

Prevalence of Certain Error Types

An examination of the various types of errors made in pronunciation shows that faulty vowels, faulty accent, omissions and faulty consonants are the most frequent (Table V). These error categories constituted 42, 18, 15, and 9 per cent of the total errors, respectively. The order of the frequency of occurrence of these errors was the same for both the *Inglis* and *Nelson-Denny* tests. This would indicate that the frequency of the error made was not merely a function of the particular tests used.

In oral reading, substitutions, repetitions, faulty vowels and omissions are the most frequent errors. These errors constitute 33, 18, 16, and 9 per cent of the total errors respectively. Thirty-three per cent of the substitutions consisted of small changes of the word, 63 per cent of the substitutions of whole words and 4 per cent were substitutions of syllables. Thirty-six per cent of the omissions were omissions of letters or syllables and 35 per cent of the insertions were insertions of letters or syllables. These findings are in only partial agreement with Swanson[12], who analyzed the oral reading of 70 poor silent readers on four 100-word selections. An exact comparison is impossible but it is evident that his students made fewer mispronunciations, that the greater number of omissions (67 per cent) were omissions of letters or syllables, and that a greater number of insertions (56 per cent) were insertions of letters or syllables. These findings agree with Swanson's in that 63 per cent of the repeti-

[12] Swanson, D. E. *Op. cit.*

TABLE V

PREVALENCE OF VARIOUS ERROR TYPES

Error type	Nelson-Denny		Inglis		Oral Reading	
	Total errors	Per cent of total	Total errors	Per cent of total	Total errors	Per cent of total
Faulty vowels	1465	23%	1381	19%	305	8%
Faulty vowels due to other errors	1363	21	1533	21	304	8
Total faulty vowels	2828	43	2914	41	609	16
Wrong accent	1001	15	1025	14	172	4
Wrong accent due to other errors	187	3	188	3	36	1
Total wrong accents	1189	18	1213	17	208	5
Omissions	949	15	1091	15	547	14
Faulty consonants	627	10	572	8	168	4
Insertions	419	6	539	8	271	7
Reversals	292	5	222	3	35	1
Substitutions	113	2	456	6	1299	33
No attempt	87	1	152	2	20	1
Repetitions	37	1	49	1	713	18
Corrections	60	1	151	2	364	9

tions were of words or groups of words. Eighty-seven per cent of the errors were single errors—in other words, the large majority of oral reading errors were rather simple in nature. Swanson likewise classified 92 per cent of his errors as 'minor'.

Amount of Gain Made by Experimental and Control Groups

Table VI shows the gains made by both experimental and control groups on the pencil and paper tests. The biggest gains were made in phonic ability which of course is to be expected because it measures most directly what was taught.

The next largest gains were made in vocabulary. Although the gains are significant statistically, the gain on the *Nelson-Denny* test was greater than that on the *Inglis* test. The reason for the smaller gain in the *Inglis* test might lie in the fact that it is composed

TABLE VI

GAINS MADE BY EXPERIMENTAL AND CONTROL GROUPS

	Experimental		Control	
	Per cent gain	SE gain	Per cent gain	SE gain
Nelson-Denny vocabulary	9	3.9	1	.6
Inglis vocabulary	4	2.7		
Nelson-Denny paragraph comprehension	6	2.1	9	2.4
Spelling	2	.8	2	.8
Phonic Ability I (syllabification)	18	6.7		
Phonic Ability II (selected correct pronunciation)	15	6.0		

of many words which are found in reading but which people use very little in speaking or writing. The gain of nine per cent is based upon raw scores. For example, the average per cent of items which were answered correctly before training was 26, while the per cent answered correctly after training was 35.9 per cent, an average gain of 9.9 per cent. This is equal to an average gain of 53 per cent over the original scores. Thus when the per cent gain is computed from the original scores instead of the perfect score as a baseline, the gain is significant also from the learning standpoint. A study of students making greatest gains in vocabulary shows that those who rank high in the *Mathematics Aptitude Test* make the biggest improvements. Students in the upper one-third in improvement had an average *Mathematics Aptitude* percentile score of 34 while those in the lowest third had an average percentile score of 19 in the same test. The gain of the experimental group in paragraph comprehension is not statistically significant nor does it exceed that made by the control group. This is essentially what Tate[13] found at the elementary school level. His experimental group showed a gain in vocabulary but not in sentence or paragraph comprehension. If the increase here found in vocabulary was real, as is evidently the case, the effect should carry over naturally to connected reading. However, it is doubtful if there were enough crucial, difficult words in the reading selections to aid in answering the questions asked. As they stand, these results show that phonic training has no effect on spelling at the college level.

Table VII shows the gains made in oral reading and pronunciation. The gains in oral reading are not as large as the pronunciation gains but many of them are statistically significant. On the average a 50 per cent gain over original scores was made in oral reading. The gains in the pronunciation columns represent an average 70 per cent gain and the CRs are all high. These large improvements seem to validate the use of phonics instruction for the improvement of pronunciation at the college level, for poor readers can make use of these principles in actual pronunciation. It must be remembered that these improvements are not due to specific coaching on the words in the test. The exercises used in training did not contain any of the test words. The improvement in pronunciation came largely due to the ability to connect visual symbols with known auditory symbols. The question as to how permanent this transfer is this research does not answer. Permanence of improvement probably depends on many factors—the emphasis during training, the memory of the student, his desire to improve, and the opportunity he has for reading.

IV. CONCLUSIONS

1. Mispronunciation of a word and lack of comprehension of its meaning often go together. On the average, 78 per cent of the

[13] Tate, H. L. "The Influence of Phonics Upon Silent Reading Response in the First Grade," *Chicago Principals' Club Reporter*, XXIX (November, 1936), pp. 8–17.

TABLE VII

GAINS IN ELIMINATION OF ERRORS MADE BY EXPERIMENTAL AND CONTROL GROUPS IN PRONUNCIATION AND ORAL READING

	Nelson-Denny Test				Inglis Test				Paragraph Errors			
	Experimental		Control		Experimental		Control		Experimental		Control	
	Gain	C. R. of gain	Gain	C. R. of gain	Gain	C. R. of gain	Gain	C. R. of gain	Gain	C. R. of gain	Gain	C. R. of gain
Faulty vowel	8	6.9	—3	2.1	10	10.4	—2	1.0	2	2.8	0	.0
Faulty vowel necessitated by other errors	10	8.8	—2	1.1	12	8.4	0	.0	1	1.5	0	.0
Total faulty vowels	18	5.6	—6	1.8	22	18.8	—2	1.0	3	2.5	0	.0
Faulty accent	7	6.7	—1	.8	9	8.6	—1	1.9	1	2.4	0	.0
Faulty accent necessitated by other errors	3	4.6	0	.0	2	7.1	—1	1.9	0	.0	—1	.4
Total faulty accents	9	10.3	—1	.6	10	20.8	—2	1.5	1	3.3	—1	.5
Omission of sound	9	16.6	1	.8	10	9.1	0	.0	1	3.0	0	.0
Insertion of sound	5	10.5	0	.0	6	8.2	1	1.2	1	2.6	0	.0
Faulty consonant	4	7.0	0	.0	5	8.9	0	.0	1	3.1	—1	.4
Reversals	3	5.0	0	.0	0	.0	0	.0	0	.0	0	.0
Substitution of word	2	6.8	0	.0	3	6.6	1	1.5	4	3.5	1	.9
Slight change of word	1	10.4	0	.0	1	3.7	0	.0	3	3.5	—1	.9
Sub. of word and slight change	3	7.3	0	.0	4	6.2	1	.9	7	3.1	—1	.8
No attempt	3	2.6	1	1.3	3	6.2	1	.9	2	5.7	0	.0
Sub. of sound	1	4.9	1	.7	2	5.0	—1	.8	1	2.5	0	.0
Repetition of syllable									3	4.1	0	.0
Repetition of word									3	2.7	—2	1.4
Average	5	7.6	0	.0	5	6.9	0	.7	2	2.6	0	.0
Words of one error	12	20.8	—3	2.0	16	10.8	—1	.4	13	313	2	.4
Words of two errors	6	9.4	—1	.7	7	9.8	—2	1.9	0	.0	0	.0
Words of three or more errors	9	7.4	1	.3	9	10.7	—5	4.2	2	4.5	0	.0

mispronunciations in this study were accompanied by inaccurate comprehension. When a student makes many mispronunciations in reading aloud, the chances are good that he does not understand the words which he pronounces.

2. Oral reading errors can be recorded with a high degree of accuracy by personal recording of a trained examiner. This is significant from a clinical standpoint for those to whom phonographic techniques are not available. With practice and careful attention the recording can become reliable and objective.

3. The phonic ability test used in this research has a high reliability for poor readers and is valid for indicating weaknesses in phonic ability. As an aid in training, its usefulness will be highest when responses on individual items are used as an indication of knowledge of the particular pronunciation principle.

4. Substitutions, repetitions, faulty vowels and omissions are the most frequent in oral reading. Faulty vowels, faulty accent and omissions are most frequent in pronunciation. The necessity for connected thought and continuous vocalization in oral reading produces an abundance of substitutions and repetitions. Thus any instruction in oral reading should involve training to overcome repetitions and omissions. The high frequency of these errors justifies more practice in oral reading than in phonics, although the latter should be included if mispronunciations are common in a student's oral reading.

5. At the college level phonic training is an effective technique for the improvement of pronunciation, oral reading, and reading vocabulary. The fact that no improvement in paragraph comprehension resulted may have been due to the fact that the particular tests used did not contain difficult key words on which comprehension of the general meaning depended. Lack of improvement in spelling may have been due to the type of words in the spelling test or to inertia in applying phonic principles. Certainly knowledge of pronunciation is an important factor in learning to spell.

The value of phonics in pronunciation in contrast to more sight training lies in the fact that the student is given a tool which will enable him to attack new and unfamiliar words while sight training would improve only the particular words studied. Although it is an aid in oral reading and vocabulary, it should not be used exclusively. Improvement in vocabulary should also include training in suffix and prefix cues, motivation in using the dictionary and any other helpful devices. The value of this research has been to indicate that phonic training is one technique which may be used in the improvement of vocabulary at the college level.

PRINCIPLES OF PRONUNCIATION

1. Division of syllables
   a. Consonants usually go with the following vowel: se-cret; so-lo.
   b. Consonants are split if they cannot be blended: pic-nic; al-fal-fa.
   c. Doubled consonants are split: col-lege; sil-ly.
   d. If the accent is on the first syllable, the following consonant is pulled into it: res-i-den-tial; pal-ace.

2. Long and short vowels
   a. Accented vowels are short except when they end the syllables: cab-bage; pref-er-ence; so-fa.
   b. All vowels tend to have the same sound—short u—when they are not accented; con-duct; o-pin-ion; salute.

3. *G* and *C*
   a. G and C are hard except when they come before e, i, and y: cir-cus; cen-ter; cab; cake; game.

4. Before endings *i* keeps its short sound: collision; initial.

5. Endings which have the accent just before them:

1. real	funereal
2. tious	ambitious
3. tion	question
4. tiate	negotiate
5. tial	spatial
6. cious	gracious
7. ciate	appreciate
8. cial	racial
9. cian	politician
10. sion	collision
11. ious	harmonious
12. uous	sinuous
13. ity	complexity
14. xious	anxious
15. ic	dramatic
16. ian	median

6. Vowel and consonant sounds:

1. au	haul
2. aw	law
3. ay	ray
4. ai	rain
5. ea	eat
6. ee	keep
7. ei	deceive
8. ew	few
9. ow	prowl
10. ie	field
11. ior	behavior
12. oa	foam
13. oi	boil
14. ou	out
15. oy	boy
16. bu	abuse
17. cu	cute
18. ju	June
19. lu	lunatic
20. mu	music
21. pu	compute
22. qu	quite
23. ru	ruin
24. eu	feud
25. tous	felicitous
26. eign	reign
27. exh	exhaust
28. arch	archbishop
29. dge	bridge
30. gn	gnat
31. gh	ghost
32. ign	sign
33. rh	rhetoric
34. mb	dumb
35. gue	vague
36. eau	bureau
37. ier(l)	collier
38. iar(l)	familiar
39. que	casque
40. ion(n)	bunion
41. iar(n)	Spaniard
42. eigh	weight
43. kn	knot
44. alk	balk
45. pt	ptomaine
46. ph	telephone
47. pn	pneumonia
48. ps	psychology
49. sten	listen
50. dia	diabetes
51. ture	conjecture
52. stle	castle
53. wr	wretched
54. equi	equidistant
55. ize	memorize
56. duous	assiduous
57. tu	actual

7. Vowel sounds

Long		*Short*
cake	a	cat
see	e	hen
fight	i	pig
open	o	cot
few	u	sofa

VOWELS

A

au

auction
because
maugre
nautilus
authentic
nautical
raucous
auk
fraud
baul
laud
fault
laudanam
distraught

aw

awe
crawl
macaw
awful
caw
lawn
awkward
gawky

bawdy
brawn
fawn
haw

ate

accurate
collegiate
affectionate
modulate
resuscitate
associate
mediate
appropriate
meditate
obstinate
palpitate
participate
precipitate
predicate

ay

ray
essay
slay
stay
spray
jay
gray
flay
dismay
away
delay
bray
hurray
fray

ai

rain
aid
certain
captain
complaisant
aigretto
lackadaisical
chilblain
migraine
laid
acclaim
attain

E

initial ea

eat
ease
eaves
eagle
eastern
east
eaten
ear

ee

genteel
preen
flee
beetle
keep
decree
banshee
beseech
canteen
careen
fleecy
esteem
heedless
peevish
fee

medial ea

meadow
heaven
bean
lacteal
lineal
cochineal
commonweal

peace
dream
leather
beacon
breach
feasible
cleavage

initial e in stressed syllables

emanate
estimable
emigrate
emulate
enervate
erudite
envy
enzyme
epaulet
enviable
epigram
episode
epitaph
errand
epithet

ei

conceive
seismograph
receive
conceit
leisure
seizure
sheik

stein
eider
skein
veil
geisha
seine
eight
surveillance

eau

bureau
trousseau
beaux
chateau
tableau
plateau
tonneau
Juneau
portmanteau

ew

askew
eschew
slew
few
skew
hewn
lewd
mew
pew
pewter
curfew
shrew
sinew
spew

ie

believe
fierce
hygiene
irretrievable
zwieback
hield
field
fiend
niece

lion

medallion
million
battalion
vermillion
postillion
stallion
pillion
rebellion
scallion
trillion

oa

broach
oak
shoal
foam
oar
groan
boar
board
boast
boat
coach
coax
hoax
loam

oi

foible
poinsettia
anthropoid
exploit
oily
goiter
broil
coin
invoice
rejoice
moisture
voice
poise

oy

oyster
alloy
envoy
employ
soybeans
joyous
loyal

I

ial

bronchial
filial
genial
participial
ministerial
remedial
professorial
imperial
colonial
jovial
bestial
molarial
matrimonial
medial
triennial
primordial

nion

union
communion
bunion

companion
dominion
minion
onion
pinion

ior

behavior
interior
junior
superior

iar, ier

billiards
collier
spaniard
familiar
briar
seculiar
peculiar

O

voyage
royally

ow (medial)

dowager
rowdy
browed
cowed
dowdy
down
gown
growl
howl
jowl
prowl
endowment
vowel
cowl

ob

obdurate
obsequy
obstinant
obelisk
object
obligation
oblivion
observant
obstruct
obtuse

ou

bound
cloud
ground
found
mound
oust
slough
courthouse

out
accountant
carousal
espousal
soup
trousseau
cousin
courteous

ous

abstemious
amphibious
assiduous
calamatous
idolatrous
indigenous
felicitous
miraculous
conspicuous
advantageous
contemporaneous
congruous
carnivorous
anonymous
amorous

ow (final)

minnow
window
yarrow
winnow
sparrow
wallow
blow
slow
marshmallow
hollow
swillow
bellow
furrow

U

initial u

ubiquitous
usurp
unbiased
urban
unit
use
usurer
uvula
unicorn
unify
unionist
unique
unison
unitarian
university

u after f

fuel
fuselage
fugitive
futility
fuchsia
fugue
fume
fusilade
fusion
futurity
fuse
fumigate

u after l

lucid
ludicrous
allusion
lucre
alluvial
collusion
voluminous
evolution
lubricate
luminary
luminous
lunacy
lunatic
allure
allude

u after b

bubonic
bugle
attribution
abuse
butte
ambulance

u after c

elocution
acute
emasculate
acumen
cucumber
cue
huge
cuneiform
lacuna

u after h

hue
exhume
huge
human

u after p

dispute
spurious
amputation
impugn
puberty
puissant
puma
putative
spume
impute
repute

u after m

museum
mucous
mulatto
munificent
muleteer
muse
mural
mucilage
mutiny
mutineer

gue

vague
rogue
morgue
meringue
harangue
brogue
vogue
plague

eu

feud
euchre

pneumatic
eugenics
euphony
maneuver
rheumatic
leucocyte
eucalyptus
therapeutic
deuce
eulogize
euphonious
eunuch

u after j

July
judiciary
Juneau
juvenile
julep
jury
Judith
jurist
jurisdiction
juniper
jute
judicial

u after r

ruin
ruminant
perusal
rudimentary
ruby
Rubicon
rubicund
rubric
ruination
rumor
construe
quadruped

u after s

assure
assume
persuance
insuperable
presume
pursue
pursuit
resume
suit
sumac
superman
supernatural

Consonants

tch

catch
satchel
scutcheon
splotch

ratchet
etch
patch
watch
bewitch
hatchway

batch
dispatch
dutch
escutcheon
fetch
fitch

mb

dumb
aplomb
succumb
jamb
comb
numb
entomb
hecatomb
limb
plumb

ck

back
chicken
kopeck
heckle
amuck
beckon
black
cackle
cassock
fickle
fanatic
haddock
hassock
jockey

ca, co, cu

cadet
cafe
calcify
ducat
truculent
laconic
carnelian
basilica
cab
cabbage
cabinet
cable
caboose
cackle
cairn

ci, cy

city
cynic
cyclic
cynosure
complacency
plebiscite
taciturn
cinnamon
cistern
circumspect
citrous
cygnet
cypress
democracy
citizen

ce

cent
cerebellum
precedent
lacerate
cockatrice

centipede
divorce
princess
century
distance
alsace
census
centennial
centurion
educe

arch

archbishop
architect
architrave
archeaology
patriarchial
architectural
archangel
archaic
archdeacon
archway
archduke

sc

science
abscess
asceticism
convalescence
irascible
proboscis
rescind
sconce
emasculate
scimitar
obsolescent
irredescent
incandescence
evanescent

final c

cosmic
bubonic
cathartic
ecclíptic
astrologic
elliptic
barometric
aspic
authentic
automatic
catholic
dramatic
elastic

cc, cci, cce

accuse
flaccid
accelerate
accessory
accidental
account
succinct
vaccine
accustom
accede
access

accept
success
moccasin

cial

racial
beneficial
prejudicial
superficial
social
facial
judicial
official
sacrificial

cious

gracious
capricious
auspicious
fallacious
malicious
meretricious
pertinacious
sagacious
tenacious
contumacious
mendacious
perspicacious
pugnacious
veracious

ciate

appreciate
denunciate
excruciating
enunciate
associate
annunciate

cient

coefficient
proficient
self-sufficient

cion, cian

physician
logician
statistician
coercion
electrician
politician

dj

adjust
adjunct
adjacent
adjourn
adjoin
adjective
adjournment
adjudge

gn

gnat
gnome
cologne
lorgnette
monseigneur
sovereign

gneiss
gnarl
gnaw
gnash
cognac
mignonette
siegniory
signor

du

individual
fraudulent
pendulum
procedure
pendulous
individualize
nodule
undulate
graduate

dge

bridge
cartridge
hodge-podge
smudge
hedge
nudge
dodging
porridge
dodge

gh

ghost
ghetto
gherkin
sorghum
ghastly
ghoul
afghanistan
dinghy

igm

diaphragm
paradigm
phlegm

ight

knight
flight
fight
right
tight
sight
light

igh

sigh
thigh
nigh

ough

dough
though
borough
furlough
brougham
rough
tough
enough
trough
fought

pt

ptomaine
ptarmigan
Ptolemy

teous

beauteous
duteous
plenteous

sten

listen
chasten
fasten
hasten
moisten

pn

pneumonia
pneumatic

ign

design
benign
coign
malign
arraign
condign
deign
sign
consign
impugn
ensign

ge

page
camouflage
avenger
refulgent
tragedian
effulgence
assemblage
baggage
barrage
divulge
harbinger
margin
nitrogen
regency

gi, gy

ginger
agitator
gyroscope
dirigible
gibber
gibe
flagitious
giblets
gibbet
gyve
magic
gingersnap
gypsy
stingy

ga, go, gu

golf
gauntlet
goiter
gondola
gorilla
gazette
gall
gaily
galaxy
goggles
gopher
garret
gauntlet
gossamer
guzzle

g before con.

aggregation
grotesque
grass
ground
glitter
glee
grotto
grim
aggrandize
gladiolus
glossary
globular
grieve
grenade

kn

know
knave
knotty
knead
knight
knickerbocker
knapsack
knife
knack
knit
knoll
knuckle
Knoxville

rh

rhythm
rheostat
rheumatism
rhetoric
rheum
Rhine
Rhinoceros
rhododendron
rhombus
rhubarb
rhapsody

stle

castle
epistle
wrestle
apostle
hustle
jostle
mistletoe
nestle
ostler
pestle
rustle
thistle

sure

treasure
censure
fissure
leisure
composure
cynosure
erasure
disclosure
pleasure
pressure
ensure
exposure
insurance
measure
usurer

alk, alf, alm

calf
chalk
palm
half
balk
calm
balm

exh

exhaust
exhilarate
exhort
exhale
exhibit

ps

psychology
psychiatry
psalm

wr

wretchedness
wreath
wrinkle
wreak
wrathful
wrong
wrought
wren
wreck
wrought

ph

phosphorescence
amorphous
apostrophe
asphyxiate
ephemeral
esophagus
phlegm
philosopher
sulphur
sylph
gopher
nephew
aphorism
aphid
elephant

sion

excursion
aversion
dimension
incursion
comprehension
compassion
collision
artesian
adhesion
collusion
confession
erosion
diffusion
discursion

ture

creature
conjecture
forfeiture
nurture
portraiture
lecture
moisture
nature
culture
actual
capture
fixture
furniture
picture
expenditure

tion

nation
apportion
attention
capitalization
capitulation
desecration
dereliction
concatenation
depredation
question
function
caution
conjunction
auctioneer
avocation

tious

cautious
propitious
captious
factitious
nutritious
ostentatious
facetious
vexatious
pretentious
propitious
captious
contentious
infectious
superstitious

tu

punctual
maturation
incestuous
infatuated
tempestuous
tumultuary
voluptuary
sumptuary
unctious
estuary
actuate
actuary
fatuous
petulance
ritual

tial

spatial
substantial
differential
equinoctial
initial
martial
nuptial
palatial
celestial
bestial
residential
preferential
presidential
influential

tual

habitual
ritual
punctual
ineffectual
virtual
textual
eventual
factual

tiate, tiation

initiate
insatiate
ingratiate
propritiation
negotiate
propitiate
negotiation
expatiate
differentiate
substantiate
novitiate

PREFIXES AND SUFFIXES

dia

diabetes
diabolic
diagnose
diameter
diaphragm
diatribe
diagonal
diametric
diadem
diagram
dialect
dialogue
diameter

equi

equiangular
equilateral
equilibration
equilibrist
equinox
equinoctal
equivocal
equivalent
equivocate
equimultiple
equidistant
equilibrium

psych

psychic
psychologist
psychiatry
psychology

itis

appendicitis
meningitis
tonsilitis
bronchitis
phlebitis

ile

agile
docile
facile
fragile
senile
sterile
volatile
fabrile
fertile
futile
hostile
infantile
mercantile
prehensile
projectile

tory

transitory
laboratory
peremptory

predatory
mandatory
monitory
satisfactory
territory
unsavory
observatory
prefatory
purgatory
repertory
respiratory
statutory
derogatory

ize

mercerize
minimize
mobilize
tantalize
terrorize
theorize
tyrannize
visualize
vulcanize
patronize
satirize
modernize
monopolize
temporize

vowel before double cons.

effrontery
appellant
appellation
apparatus
assassin
ballet
ebullition
insurrection
intermittent
mollification
silhouette
straddle
dullard
brilliant

cy

constituency
decency
despondency
emergency
diplomacy
discrepancy
exigency
fallacy
fluency
hesitancy
inconstancy
indecency
infancy
intimacy
intricacy
legacy

real

corporeal
empyreal

funereal
incorporeal
lineal

bility

reliability
legibility
risebility
solubility
variability
volubility
eligibility
ability
nobility
liability
possibility
probability
respectability
sensibility

able, ible

communicable
compatible
contemplate
crucible
despicable
incorruptible
indelible
conceivable
conformable
considerable
convertible
culpable
debatable

ence, ance

competence
compliance
complaisance
contrivance
convalescence
corpulence
countenance
alliance
deference
diffidence
divergence
encumbrance
excrescence
exuberance

ity

conductivity
conformity
consanguinity
elasticity
deformity
dimity
divinity
docility
duplicity
facility
frivolity
constitutionality
continuity
cordiality
debility

ble, cle, ple, etc.

manacle
epistle
castle
amiable
amicable
charitable
despicable
dirigible
enviable
follicle
grumble
impalpable
kindle
knuckle
cuticle

tive

remunerative
motive
meditative
vindictive
nutritive
preservative
prohibitive
recitative
regenerative
vegetative
transitive

tentative
selective
instantive
purgative

ette

etiquette
coquette
silhouette
marionette
marquisette
roulette
gazette
gorgette
mignonette
palette
pantalette
flannelette

verbs

withstand
forbear
retain
contest
undertake
admire
accent
addict
affix
annex

attribute
combat
combine
commune
compress
desert
digest
purport

nouns

bystander
intake
revenue
contest
forbear
underground
absence
admirable
abstract
accent
addict
affix
annex
attribute
combat
combine
commune
compound
compress
concert

INSTRUCTIONS FOR ADMINISTERING PHONIC ABILITY TEST

PART I

See that each student has a pencil. Be sure that you have some extra ones. Distribute Part I face downward. Distribute instruction sheet face upward. Then say,

"Look at the paragraph under Part I. (Pause; then read aloud the directions given there.) Are there any questions? (Pause) Turn your paper over in front of you; place your name in the upper right hand corner (pause) and start working".

At the end of 15 minutes, say "Stop. Keep your instruction sheets but pass Part I to your right." When these have been collected, distribute Part II, face downward. Then say, "Look at the directions under Part II. (Read directions and list of sounds.)

"If you will look at the examples you will see that first word, b-a-k-e-r, has the following choices: 1. bākrē 2. bākur 3. baker 4. bakru. The second choice is correct so a two (2) is put in the parentheses to the right. N-o-i-s-e has the choice of 1. nōis 2. nīs 3. nōsē and, of course, the first choice is correct. B-a-t has three choices: 1. bät 2. bat and 3. bāt. The second is correct so a 2 is placed in the parentheses. The four choices to college are 1. kalēg 2. kōlij 3. kōlig 4. kālij and, of course, kālij is correct.

"Are there any questions? (Pause) Turn over the test, place your name in the upper right hand corner (pause) and begin work".

After 35 minutes say, "Stop. Pass your tests to the right."

TEST OF PHONIC ABILITY

Instruction Sheet

PART I

This is a test of your ability to break nonsense words and real words up into syllables. Draw a straight line after the last letter in each syllable. Some of the words contain only one syllable; others contain more. You need not draw any lines on the one-syllable words. Below are some actual words divided according to syllables:

foot/stool cat sing/ing fam/i/ly

PART II

This is a test to find out if you can follow certain principles of pronunciation. Select the best of the four pronunciation choices given for each of the nonsense words and write its number in the space at the right of the line. You do not need actually to know rules in order to arrive at the correct response; you can think of similar words and compare their pronunciation with that of the nonsense words. For example, "meck" makes one think of Jack, pack, cracker, etc. Thus we would conclude that the ck has the k sound, and pronounce it "mek". Be careful to choose the pronunciation that would be most likely to be used. REMEMBER THAT THE FOUR PRONUNCIATION CHOICES ARE SPELLED AS THEY WOULD BE SOUNDED ACCORDING TO THE SYMBOLS BELOW. Refer to these symbols as much as you need to. Note that no mark above a vowel indicates a short sound.

ā	as in Kate or made
a	as in cat or sad
ä	as in father, arm, law
ē	as in be or zero
e	as in Ted or egg
ow	as in cow or how
oi	as in soil or loiter
ī	as in ice or knife
i	as in pit or it
ō	as in no or code
oo	as in smooth or boot
ū	as in use or few
u	as in under or the a in sofa

Examples

baker	1. bākrē 2. bākur 3. baker 4. bakru	(2)
noise	1. nois 2. nōis 3. nīs 4. nōsē	(1)
bat	1. bāt 2. bat 3. bāt	(2)
college	1. kālēg 2. kōlij 3. kōlig 4. kālij	(4)

At the signal, turn to the test designated by the examiner. Do not spend too much time on any one item. Try to answer every one.

PART I

1. h i s t e n
2. n o i s t l e
3. p n u m
4. p a n c i a t e
5. s t i l o
6. m u n t e n
7. p s o t
8. v a i p e r
9. e q u i d u m
10. d i a s e m
11. g u p i t i s
12. c o n p u d
13. d e x g o g u e
14. t a m u
15. u b i d g e
16. d a p u
17. r u k e r
18. b i c a t u r e
19. p a s p h i m
20. a r c h e m p
21. d a c i a l
22. a b n e o u s
23. e l i e r
24. j u v e
25. r e g i c
26. s u b l o g u e
27. s a f o o
28. a r c h p u k
29. t i c i o u s
30. g a s i o n
31. f e u n t e r
32. w r o g g
33. a p t i o n
34. g h a m
35. s a l f
36. r h a m b u
37. b e n t i a l
38. p a l k
39. b i s u a p e
40. t a m t i o u s
41. k n a d
42. h i n r i o u s
43. t e i g h
44. b r i c l e
45. s m u o t h
46. k o u g h
47. m o i t h
48. g u d g e
49. a c k b i l i t y
50. r a m b
51. p o g n
52. l a s q u e
53. p a c t u a t e
54. d u s c i o u s
55. d a s c u t
56. n a c e
57. k o g e
58. g u i g u e b
59. n i s r i a t e
60. g r e g a f
61. c y m t u r
62. c a v c i p
63. r e c c i t
64. d r a t e
65. g a g u s
66. p l i f
67. p o a f
68. f o w p e r
69. k u t c h
70. b a c c u m
71. t r i g n
72. m o g u e
73. b a l g h a t
74. m a c c e t

75. n e v s u r e
76. c a l l i o n
77. b a m s i o n
78. p u d i m
79. d a t i a t e
80. q u i m
81. b a j k i l e
82. o b t u r
83. n o y t e n
84. t a y s e n
85. v a p d o w
86. k l i g h b
87. u l f u g
88. e a p u t
89. c a g e a u
90. h i e n
91. p r a u t
92. t a w j u m
93. b e n n i o n
94. r a n i a l
95. m i l o u s
96. v o u k e
97. m a l a n t i v e
98. c a n b e r i z e
99. l a f f u t
100. g h e e j
101. n a t u r a l i z a t i o n
102. i n a u g u r a t e
103. d e m o c r a c y
104. f i l i b u s t e r
105. f r a n c h i s e
106. l e g i s l a t i o n
107. r a t i f i c a t i o n
108. i n d e m n i t y
109. s e d i t i o n
110. s a n i t a t i o n
111. e m b a s s y
112. p r e s e r v a t i o n
113. e n e r g y
114. s a t u r a t e d
115. e v o l u t i o n
116. n e u t r a l i z e
117. e f f i c i e n c y
118. d e c o m p o s i t i o n
119. e x p e r i m e n t
120. a q u e o u s
121. b u o y a n c y
122. v o l a t i l e
123. t r a n s p o s e
124. b a l a n c e
125. s o l u t i o n
126. v e r t i c a l
127. c o n s e q u e n t
128. e q u i l a t e r a l
129. v e r i f y
130. i n f i n i t e
131. a x i o m
132. m y t h
133. s a l u t a t i o n
134. m e t a p h o r
135. f i c t i t i o u s
136. c h a r a c t e r i z a t i o n
137. a n e c d o t e
138. c o h e r e n t
139. s o n n e t
140. a n a l o g y

PART II

1. histen	1. histen 2. histun 3. hisun 4. histēn	(3)
2. noistle	1. noisul 2. noistul 3. noistōl 4. nōstul	(1)
3. pnum	1. punum 2. pinum 3. punoom 4. num	(4)
4. panciate	1. pansiat 2. panzēāt 3. panshēāt 4. pancēut	(3)
5. stilo	1. stīlō 2. stīloo 3. stīlu 4. stilä	(1)
6. munten	1. muntun 2. mūntōn 3. mūntun 4. munun	(1)
7. psot	1. sät 2. pusat 3. pusot 4. soit	(1)
8. vaiper	1. vapur 2. vīpur 3. vāpur 4. vāipur	(3)
9. equidum	1. ēkwudum 2. ekūdum 3. ekudum 4. ekwīdum	(1)
10. diasem	1. diuzem 2. dīusem 3. dēusem 4. diasem	(2)
11. gupitis	1. gupētus 2. gūpitus 3. gupitīs 4. gūpītus	(4)
12. conpud	1. cōnpud 2. cōnpūd 3. cānpud 4. cōnpood	(3)
13. dexgogue	1. deksōgu 2. deksgägū 3. deksgäg 4. deksgägoo	(3)
14. tamu	1. tāmu 2. tāmū 3. tamä 4. tāmoo	(2)
15. ubidge	1. ubij 2. ūbij 3. ubīj 4. ubidgu	(2)
16. dapu	1. dāpū 2. dapoo 3. dāpoo 4. dāpu	(1)
17. ruker	1. rūker 2. rūkur 3. rookur 4. rūur	(3)
18. bicture	1. bikchur 2. bischur 3. bikture 4. biktur	(1)
19. pasphim	1. paspim 2. pāspim 3. pashim 4. pasfim	(4)
20. archemp	1. arkemp 2. archemp 3. arkhemp 4. archēmp	(1)
21. dacial	1. dasēul 2. dāshul 3. dāsēul 4. dākiul	(2)
22. abneous	1. ābnēōs 2. abniōus 3. abnius 4. abnus	(3)
23. elier	1. elēur 2. ēlēur 3. elur 4. ēlyur	(4)
24. juve	1. jūv 2. joov 3. jūvu 4. jūf	(2)
25. regic	1. regik 2. rēgik 3. regis 4. rejik	(4)
26. sublogue	1. sublägoo 2. sublägū 3. sublōgū 4. subläg	(4)
27. safu	1. safoo 2. säfoo 3. säfu 4. säfū	(4)
28. archpuk	1. arkpuk 2. archpuk 3. arkhupuk 4. arkpūk	(2)
29. ticious	1. tisēus 2. tikus 3. tishus 4. tīkēus	(3)
30. gasion	1. gāzhun 2. gāshēun 3. gashun 4. gasēun	(1)
31. feunter	1. funtur 2. fūntur 3. fēuntur 4. fünter	(2)
32. wrogg	1. wurāg 2. wurōg 3. räg 4. wäg	(3)
33. aption	1. aptēun 2. aptun 3. apshēun 4. apshun	(4)

34. gham	1. gam 2. ham 3. guham 4. guhäm		(1)
35. salf	1. sälf 2. säf 3. sālf 4. salf		(2)
36. rhambuf	1. rambuf 2. ruhambuf 3. ambuf 4. hambuf		(1)
37. bential	1. benshul 2. benshēul 3. benzhul 4. bentēul		(1)
38. palt	1. pät 2. pält 3. päl 4. pāt		(2)
39. bisuape	1. bīsāp 2. bisäp 3. bīsooäp 4. bīswāp		(4)
40. tamtious	1. tamshēus 2. tamtēus 3. tamtius 4. tamshus		(4)
41. knad	1. nad 2. ku-näd 3. kunād 4. käd		(1)
42. hinrious	1. hinrēōs 2. hinrus 3. hinrius 4. hinrīus		(3)
43. teigh	1. tīg 2. tēg 3. tē 4. tā		(4)
44. briclе	1. briclē 2. bricul 3. brīclē 4. briclu		(2)
45. smuoth	1. smūth 2. smoot 3. smūäth 4. smōth		(3)
46. kough	1. kōg 2. kowg 3. kow 4. kuf		(4)
47. moith	1. moith 2. mōīth 3. mäth 4. mōth		(1)
48. gudge	1. guju 2. guj 3. gūju 4. gudgu		(2)
49. ackbility	1. akbiluti 2. akbīluti 3. akbilīti		(1)
50. ramb	1. ramb 2. ram 3. rambu 4. rāmb		(2)
51. pogn	1. pōn 2. pōgun 3. pōg 4. päg		(1)
52. lasque	1. laskū 2. lasku 3. lāskwu 4. lask		(4)
53. pactuate	1. paktūāt 2. pastūāt 3. paktūt 4. pakchooāt		(4)
54. duscious	1. dusēus 2. duskēus 3. dusus 4. dushus		(4)
55. dascut	1. dasut 2. dasoot 3. daskut 4. dāsūt		(3)
56. nace	1. nāk 2. nās 3. nak 4. nāsu		(2)
57. koge	1. kōgu 2. kōg 3. kōj 4. käg		(3)
58. guigueb	1. gīgeb 2. gwīgweb 3. gūigweb 4. gīgweb		(4)
59. nisriate	1. nisrēātu 2. nisrāt 3. nisrut 4. nisrēāt		(4)
60. gregaf	1. greguf 2. jreguf 3. grējuf 4. jregaf		(1)
61. cymtur	1. simtur 2. kimtur 3. kimtur 4. kimtūr		(1)
62. cavcip	1. kafkup 2. kavkip 3. savkip 4. kavsip		(4)
63. reccit	1. rekut 2. reksut 3. rēkut 4. rekīt		(2)
64. drate	1. drāt 2. drat 3. drät 4. drātu		(1)
65. gagus	1. gājus 2. jājus 3. gāgus 4. gajus		(3)
66. plif	1. plif 2. pluf 3. plēf 4. plīf		(1)
67. poaf	1. pāf 2. pōf 3. päf 4. paf		(2)
68. fowper	1. fowpur 2. fōpur 3. fäpur 4. fōpēr		(1)
69. kutch	1. kut 2. kutchu 3. kucht 4. kuch		(4)
70. baccum	1. bakum 2. baksum 3. baksūm 4. bāksum		(1)
71. trign	1. trīn 2. trin 3. trig 4. trigun		(1)
72. mogue	1. mōgū 2. mōg 3. mägū 4. magu		(2)
73. balghat	1. balgut 2. balhut 3. balguhut 4. bālut		(1)
74. maccet	1. makut 2. mākut 3. masut 4. maksut		(4)
75. nevsure	1. nevsūr 2. nevshur 3. nevsur 4. nēvsūr		(2)
76. callion	1. kalēun 2. kalēon 3. kalun 4. kalyun		(4)
77. bamsion	1. bamsēun 2. bāmsēun 3. bämsun 4. bamshun		(4)
78. pudim	1. pudum 2. pūdum 3. pudēm 4. pädum		(2)
79. datiate	1. dāshēāt 2. dātēāt 3. dāshēät 4. dātēät		(1)
80. quim	1. kwim 2. kūim 3. kim 4. kūm		(1)
81. bajkile	1. bajkīlu 2. bajkulē 3. bajkīl 4. bajkul	(3) or	(4)
82. obtur	1. äbtur 2. ōbtur 3. ōbtūr 4. ubtur		(1)
83. noyten	1. noitun 2. nōtun 3. nōiyun 4. näten		(1)
84. taysen	1. tasun 2. tyāsun 3. täsun 4. täsun		(4)
85. vapdow	1. vāpdow 2. vapdow 3. vapdō 4. vapdu		(3)
86. kligh	1. klīg 2. kligb 3. kli 4. klī		(4)
87. ulfug	1. ūlfug 2. ūlfūg 3. ulfug 4. ufug		(3)
88. eaput	1. ēput 2. āput 3. āpūt 4. ēāput		(1)
89. cageau	1. cagu 2. cājēoo 3. cājē 3. cājō		(4)
90. hien	1. hiun 2. hīēn 3. hīn 4. hēn		(4)
91. praut	1. prowt 2. proot 3. prät 4. prāut		(3)
92. tawjum	1. towjum 2. tājum 3. tājum 4. tajum		(2)
93. bennion	1. bēniun 2. beniun 3. benun 4. benyun		(4)
94. ranial	1. rānul 2. rāniul 3. rāniāl 4. ranul		(2)
95. milous	1. milōs 2. mīlus 3. mīlōus 4. mīleus		(2)
96. vouke	1. vōk 2. vowk 3. vuk 4. vūk		(2)
97. malantive	1. mulantiv 2. mūlantīv 3. mūlantēv 4. mūlantiv		(1)
98. canberize	1. canberēz 2. canbērīz 3. canbriz 4. canbēriz		(2)
99. laffut	1. lāfūt 2. lāfut 3. lāfoot 4. lafut		(4)
100. gheej	1. gēj 2. gej 3. geuj 4. hej		(1)

FUNCTIONAL MATHEMATICAL NEEDS OF TEACHERS[1]

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Despite the fact that a considerable portion of the time in the elementary school is devoted to the study of arithmetic, and that until recently nearly every high school student studied mathematics for at least two years, relatively few students have elected mathematics as a college subject. The National Survey of the Education of Teachers[2] shows that not more than 48 per cent of college students have any contact with college mathematics, and that mathematics courses taken comprised about 21.8 per cent of all college work.

Since our modern civilization is becoming more complex as science advances, and quantitative concepts are becoming increasingly important, it would appear that something is lacking in the education of our teachers when over half of our college students are permitted to graduate without having had any directed study in the field of mathematics which has, as some of its main objectives, the development of quantitative concepts and the ability to think quantitatively.

In the fall of 1935 Central State Teachers College at Mt. Pleasant, Michigan, set out on a curriculum experiment under the direction of the Michigan Department of Public Instruction. In this experiment it was proposed to set up a general curriculum for the first two years of college work, based as far as possible on the functional needs of students. Achievement tests in elementary mathematics showed a serious deficiency in this field.[3] A diagnostic and remedial program, instituted as a result of these findings, demonstrated that in most cases these deficiencies could be overcome by remedial study and practice. A survey of research studies for the past twenty years indicated functional uses of mathematics are increasing for adults. These facts all pointed toward the desirability of determining the functional mathematical needs of teachers in their everyday life.

A check list of eighty-two mathematical items was formulated with the help of a committee composed of curriculum experts and college instructors. It was decided to have the items rated on a three point scale with respect to the following criteria: (1) frequency of use, (2) difficulty of learning, and (3) general importance; following to some extent the procedure used in the Commonwealth Teacher Training Study.[4] The criterion of "learning in school" used in the Commonwealth Study was not included in this study since it was felt that many topics might be considered to have no place in a college curriculum since they were supposed to have been learned in the elementary and secondary school.

Descriptive meanings were given to each of the three points on the scale as follows:

FREQUENCY OF OCCURRENCE

Here it is desired to know how often the teacher uses the item *outside* of his class room activities. If the item is used once a week or oftener, check column A under F. If the item is used less than once a week, but at least once a year, check column B. If it is used less than once a year, check column C.

DIFFICULTY OF LEARNING

Here it is desired to determine the relative difficulty of learning or performing the various items. If the item is one of the most difficult for you to learn or perform, check column A under D. If it is of average difficulty, check column B. If it is very easy to learn or perform, check column C.

GENERAL IMPORTANCE

Here it is desired to determine the items of most importance to the teacher in his every-

[1] A summary of *Functional Mathematical Needs of Teachers*. Unpublished Doctor's Field Study, Colorado State College of Education, Greeley, Colorado, 1937.

[2] Rugg, Earle U. *et al. National Survey of The Education of Teachers*, pp. 204–207, U. S. Education Bureau Bulletin, 1933. No. 10, Vol. 3.

[3] Heaton, K. L. and Koopman, G. R. *A College Curriculum Based on Functional Needs of Students*, p. 62. The University of Chicago Press, Chicago, 1936.

[4] Charters, W. W. and Waples, Douglas. *The Commonwealth Teacher Training Study*. pp. 254–257. University of Chicago Press, Chicago, 1929.

day life. This is differentiated from frequency of occurrence since some items which occur frequently may, however, be of extreme importance when they do occur. If the item is of great importance, check column A under I. If it is of average importance, check column B. If the item is of little or no importance, check column C.

The cooperation of thirty city and county superintendents in Michigan was secured. Check lists were furnished them to be checked by the teachers in their systems. Replies were received from 35 administrators, 136 high school teachers, 135 elementary teachers and 83 rural teachers. The lists were also checked by the 27 sophomores and 12 instructors of the general curriculum group, to determine the functional mathematical needs of the students.[5]

Using the method of Charters and Waples[6] the items were weighted and the decile ranks of each computed. Correlation coefficients between the criteria and between the different groups showed a considerable degree of agreement. In general, items used most frequently were also considered the most important while items of high frequency and importance were thought to be the least difficult to learn and perform.

Fifty-five of the eighty-two items were given a decile rank of one, two, or three (on a scale where a decile rank of one is high, a rank of 10 is low) in either frequency or importance by at least one of the groups of educators and students. These items are listed below. Starred (*) items were found to be above the median in difficulty.

1. Addition of whole numbers.
2. Subtraction of whole numbers.
3. Multiplication of whole numbers.
4. Division of whole numbers.
5. Addition of common fractions.
6. Subtraction of common fractions.
7. Multiplication of common fractions.
8. Division of common fractions.
9. Reduction of fractions.
*10. Comparison of fractions with different denominators.
11. Addition of decimal fractions.
12. Subtraction of decimal fractions.
13. Multiplication of decimal fractions.
14. Division of decimal fractions.
15. Location of decimal point.
16. Changing from common to decimal fractions.
17. Expressing common and decimal fractions as per cents.
*18. Expressing per cents as common fractions.
19. Finding a per cent of a number.
*20. Finding what per cent one number is of another.
21. Weight measure.
22. Linear measure.
*23. Square measure.
*24. Volume measure.
25. Measure of time.
*26. Metric system.
27. Temperature measure.
*28. Areas of plane surfaces.
*29. Use of ratios for comparison.
*30. Solution of problems involving proportion.
*31. Use of proportion in connection with similar figures.
*32. Averages of like quantities.
*33. Averages of unlike quantities.
34. Use of simple interest.
*35. Making graphs.
36. Interpreting graphs.
*37. Taxes.
*38. Insurance.
*39. Investments.
*40. Budget making.
41. Use of foot ruler.
42. Use of yard stick.
*43. Use of meter stick.
44. Use of tape.
45. How our number system is read.
46. How our number system is written.
*47. Appreciation of the place of quantitative thinking in our modern life.
*48. A knowledge of the content and uses of the various branches of mathematics.
*49. Use of mean.
*50. Use of median.
*51. Use of percentiles.
*52. Collecting data for problems.
*53. Analyzing data.
*54. Drawing conclusions.
*55. Evaluating results.

[5] Detailed results, including tables of frequencies and decile ranks, are found in Richtmeyer, C.C. *Functional Mathematical Needs of Teachers.* Unpublished Doctor's Field Study, Colorado State College of Education, Greeley, Colorado, 1937. Copies of the complete study are on file at the library.

[6] Charters, W. W. and Waples, Douglas. *The Commonwealth Teacher Training Study,* p. 252.

The following nineteen items were given decile ranks of four to seven in importance or frequency by at least one group. Starred (*) items were rated above the median in difficulty.

1. Comparison of decimal fractions.
2. Changing from decimal to common fractions.
*3. Expressing per cents as decimal fractions.
*4. Finding a number when a per cent of it is known.
*5. Angle measure.
*6. Volumes of solids.
*7. Tables of powers and roots.
*8. Logarithm tables.
*9. Compound interest and annuity tables.
*10. Derivation of formulas.
*11. Evaluation of formulas.
*12. Solution of simple linear equations.
*13. Pension systems.
*14. Installment buying.
*15. How our number system is constructed.
*16. Frequency distributions.
*17. Correlation.
*18. Index numbers.
*19. Quartiles.

The following eight items were given decile ranks of eight, nine, or ten in both frequency and importance by all groups rating the items.

1. Areas of curved surfaces.
2. Use of trigonometric ratios.
3. Solution of quadratic equations.
4. Solution of systems of equations.
5. Use of transit.
6. Use of calipers.
7. Use of micrometer.
8. Use of mode.

The foregoing lists indicate the relative frequencies of use, general importance, and difficulty of mathematical items commonly used by students on a general curriculum and by teachers in their everyday activities. The significant implications of the study are: (1) Many entering college freshmen need remedial work in the fundamental operations and facts of elementary mathematics; (2) there is a need for a course in remedial and functional mathematics for freshmen in a teachers college.

It is recommended, therefore, that a course in remedial and functional mathematics be organized for freshmen in a teachers college, based on the following objectives:

1. To help the student develop reasonable proficiency in simple mathematical operations common to normal everyday life experiences of teachers.

2. To help the student obtain the mathematical tools necessary to carry on work in the various curriculum fields common to all students during the two years of the general curriculum.

3. To help the student arrive at an appreciation of the value of mathematics in our modern civilization.

The lists of fifty-five and nineteen items presented in this study are suggested for inclusion in a remedial and functional mathematics course, with special emphasis being placed on the forty-four items which appear to cause the most difficulty.

It is recognized that an analysis of the mathematics actually used by teachers should not be taken as the sole criterion for determining the mathematics that should be taught to prospective teachers. It is entirely possible that other items should be taught and would be used by the teachers if taught. The activity analysis, however, can be used to determine the minimum essentials for a course in functional mathematics for teachers. Other items which seem desirable may be added. It is hoped, then, that this study may be useful as a basis for determining the minimum mathematical skills, knowledges, concepts, and appreciations, which will function in the everyday life of the teacher.

CHANGING CONCEPTIONS OF DOMINANT PROBLEMS RELATING TO MAJOR TOPICS IN GENERAL SCIENCE TEXTBOOKS*

(1911–1934)

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PROBLEM

During the past few years the need for a study of changing conceptions in the content of general science textbooks has been felt among educators. There is abundant evidence in recent textbooks indicating a change in the newer developments of science. The purpose of this study, then, will not be to develop the problem idea, but rather to show what additions or replacements of dominant problems have taken place from 1911 through 1934.

* Master's thesis (unpublished) "Changing Conceptions in General Science Textbooks" (1911–1934). State Teachers' College, Upper Montclair, N. J., 1935, X507, pp. 2, 4–13, 31–43, 91–97, 104–105. Only such portions of the above study which pertain to dominant problems relating to major topics are here summarized.

PERIOD 1911-1916

Textbook	Author	Publisher	Copyright Date
1. First Year Science	Snyder	Allyn and Bacon	1914
2. General Science	Clark	American Book Company	1912
3. General Science	Elhuff	D. C. Heath and Company	1916
4. Introduction to General Science	Rowell	The Macmillan Company	1911

PERIOD 1917-1923

Textbook	Author	Publisher	Copyright Date
1. General Science	Bedford	Allyn and Bacon	1921
2. Civic Science in Home and Community	Hunter and Whitman	American Book Company	1923
3. The Science of Common Things	Tower and Lunt	D. C. Heath and Company	1922
4. An Introduction to the Study of Science	Smith and Jewett	The Macmillan Company	1918

PERIOD 1924-1928

Textbook	Author	Publisher	Copyright Date
1. General Science	Snyder	Allyn and Bacon	1925
2. New Introduction to Science	Clark	American Book Company	1928
3. General Science	Elhuff	D. C. Heath and Company	1925
4. Science of Home and Community	Trafton	The Macmillan Company	1926

PERIOD 1929-1934

Textbook	Author	Publisher	Copyright Date
1. Our Environment: Its Relation to Us (Book I)	Carpenter and Wood	Allyn and Bacon	1933
Our Environment: How We Adapt Ourselves To It (Book II)	Carpenter and Wood	Allyn and Bacon	1934
Our Environment: How We Use and Control It (Book III)	Wood and Carpenter	Allyn and Bacon	1934
2. Problems in General Science	Hunter and Whitman	American Book Company	1934
3. The World About Us	Pulvermacher and Vosburgh	D. C. Heath and Company	1930
4. General Science for Today	Watkins and Bedell	The Macmillan Company	1932

Technique of Study

Some more or less arbitrary criteria of selection had to be set up to reduce the number of contributing sources of data sufficiently to make the investigation practicable.

The selection, therefore, was based primarily upon the availability and wide use of the eighteen general science textbooks listed.

For ease of interpretation, the twenty-four years included in this analysis have been divided into four periods as indicated. General science textbooks of four publishers were used for each period. It is interesting to note that in the last period (1929–34) one publisher brought out a three-book series which, for convenience, will be regarded as a unit. In this article reference will be made to the sixteen general science textbooks listed, that is, four for each period.

From the table of contents of each textbook examined, it appears that in nearly every instance there are sixteen major topics, namely: air, animal life, electricity, energy, forces of nature, health, heat, light, machine, matter, planets, plant life, soils, sound, water, and weather. Each topic was analyzed into as many various dominant problems as the treatment of the topic would permit. These data are presented in Table I for the purpose of showing replacements of dominant problems for each period as well as indicating the total frequency of occurrence of each problem for all periods.

The topics, as listed here in the table, correspond closely to many of those selected by Curtis, Downing, Heinman, Trafton, Webb, and Weckel in their analyses of subject-matter content in general science textbooks. One reason, perhaps, for similarity of findings is that some of the same texts were used in both investigations.

It is evident that textbooks form a source of data for studies such as this one. It is also true that inferences from data in sources of this character may be highly colored by the interpretation of the investigator. No two investigators analyzing the same materials would have distributed them under exactly the same headings.

Summary and Conclusion

The findings in Table I indicate that the classification of dominant problems under the sixteen major topics is as follows:

1. Air
   (a) How does a barometer operate?
   (b) How does a syphon operate?
   (c) Why are buildings painted?
   (d) Why will a balloon float?
   (e) What makes an airplane travel?
   (f) How are caissons used?
2. Animal life
   (a) How are animals related to plants?
3. Electricity
   (a) How does a telephone operate?
   (b) How does a radio operate?
   (c) How is television produced?
4. Energy
   (a) Why is energy essential to machines?
5. Forces of Nature
   (a) How does agriculture depend on capillarity?
   (b) How does a steam engine use forces of nature?
   (c) How does an automobile use forces of nature?
   (d) How does an airplane use forces of nature?
6. Health
   (a) How can the span of life be increased?
7. Heat
   (a) How are fires controlled?
8. Light
   (a) How is light produced?
   (b) How are motion pictures produced?
9. Machines
   (a) How does the steam engine work?
   (b) How does the gas engine work?
   (c) How does the trolley car work?
   (d) How does an electric train work?
10. Matter
    (a) Of what importance are building materials?
11. Planets
    (a) How is the earth related to the universe?
12. Plant Life
    (a) How are plants improved?
13. Soils
    (a) How can soil be improved for plant life?
14. Sound
    (a) How do musical instruments produce sound?
    (b) How does the phonograph operate?
    (c) How are sound pictures produced?

TABLE I

DOMINANT PROBLEMS DEALING WITH SIXTEEN MAJOR GENERAL SCIENCE TOPICS

Textbook Publishers

Major Topics	Allyn and Bacon				American Book Co.				D. C. Heath & Co.				The Macmillan Co.				Total Frequency
	1911–1916	1917–1923	1924–1928	1929–1934	1911–1916	1917–1923	1924–1928	1929–1934	1911–1916	1917–1923	1924–1928	1929–1934	1911–1916	1917–1923	1924–1928	1929–1934	1911–1934
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	U
1. AIR																	
A. How does a barometer operate?	×				×				×	×	×		×				6
B. How does a syphon operate?					×				×	×	×		×				5
C. Why are buildings painted?								×					×				2
D. Why will a balloon float?	×		×	×					×		×						5
E. What makes an airplane travel?		×		×		×	×	×				×		×	×	×	9
F. How are caissons used?			×	×				×				×				×	5
2. ANIMAL LIFE																	
A. How are animals related to plants?	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	16
3. ELECTRICITY																	
A. How does a telephone operate?	×	×	×		×	×			×				×				7
B. How does a radio operate?				×			×	×		×	×	×			×	×	8
C. How is television produced?				×				×								×	3
4. ENERGY																	
A. Why is energy essential to machines?	×	×	×	×	×	×	×	×	×	O	×	×	×	×	×	×	15
5. FORCES OF NATURE															O		
A. How does agriculture depend on capillarity?	×	×	×	×		×		×		O		×	×	×			9
B. How does a steam engine use forces of nature?										×							1
C. How does an automobile use forces of nature?					×												1

TABLE I—Continued

DOMINANT PROBLEMS DEALING WITH SIXTEEN MAJOR GENERAL SCIENCE TOPICS

Major Topics	Textbook Publishers: Allyn and Bacon				American Book Co.				D. C. Heath & Co.				The Macmillan Co.				Total Frequency
	1911–1916	1917–1923	1924–1928	1929–1934	1911–1916	1917–1923	1924–1928	1929–1934	1911–1916	1917–1923	1924–1928	1929–1934	1911–1916	1917–1923	1924–1928	1929–1934	1911–1934
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	U
D. How does an airplane use forces of nature?	×	×	×	×		×	×	×	×		×	×	×	×		×	13
6. HEALTH																	
A. How can the span of life be increased?	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	16
7. HEAT																	
A. How are fires controlled?	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	16
8. LIGHT																	
A. How is light produced?	×				×	×			×	×	×	×	×	×			9
B. How are motion pictures produced?		×	×	×			×	×							×	×	7
9. MACHINES																	
A. How does the steam engine work?					×								×				2
B. How does the gas engine work?	×	×					×		×	O	×	×				×	7
C. How does the trolley car work?				×		×	×	×						×	×		6
D. How does an electric train work?			×	×		×		×						×	×		6
10. MATTER																	
A. Of what importance are building materials?	×	×	×	×	×	×	×	×	×	O	×	×	×	×	×	×	15
11. PLANETS																	
A. How is the earth related to the universe?	×	×	×	×		×	×	×	×	O	×	×	×		×	×	13

TABLE I—Continued

TABLE I—Continued

DOMINANT PROBLEMS DEALING WITH SIXTEEN MAJOR GENERAL SCIENCE TOPICS

Textbook Publishers

Major Topics	Allyn and Bacon				American Book Co.				D. C. Heath & Co.				The Macmillan Co.				Total Frequency
	1911–1916	1917–1923	1924–1928	1929–1934	1911–1916	1917–1923	1924–1928	1929–1934	1911–1916	1917–1923	1924–1928	1929–1934	1911–1916	1917–1923	1924–1928	1929–1934	1911–1934
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	U
12. PLANT LIFE																	
A. How are plants improved?	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	16
13. SOILS																	
A. How can soils be improved for plant life?	×	×	×	×	×	×	×	×	×	O	×	×	×	×	×	×	15
14. SOUND																	
A. How do musical instruments produce sound?									×		×	×	×	O			4
B. How does the phonograph operate?		×			×	×											3
C. How are sound pictures produced?				×				×							×	×	4
15. WATER																	
A. How is water used as a means of transportation?	×	×	×	×		×		×						×	×	×	9
B. How does a water supply system operate?		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	15
16. WEATHER																	
A. How does location affect weather?	×	×	×	×		×	O	×		×		×	×	×	×	×	12
B. What does the weather bureau do?	×	×	×	×	×			×	×	×	×	×	×	×	×	×	14

× Indicates a dominant problem. For convenient reference in this table the dominant problems are arranged under each major topic.

This table should be read as follows: In Allyn and Bacon textbook, problem A occurred only in period 1911-1916. It failed, however, to appear in periods 1917-1923, 1924-1928, 1929-1934 as a dominant problem etc.

Column U, total frequency, 1911-1934, represents the sum total of all periods for each major topic.

Wherever O occurs, major topic was omitted from textbook.

15. Water
   (a) How is water used as a means of transportation?
   (b) How does a water supply system operate?
16. Weather
   (a) How does location affect weather?
   (b) What does the weather bureau do?

The following brief comments may be made on these major topics in view of the findings of this investigation:

1. Air—In the first period (1911–1916) for each author an analysis shows a shift in emphasis from the dominant problems regarding the barometer and the syphon to the airplane and the caisson. This is to be expected because of the recent developments of air transportation and the increased building of tunnels and subways. The balloon received some treatment in nearly all the periods. The health aspects of the topic "Air" received minor consideration and, therefore, was not classified as a dominant problem.

2. Animal Life—The dominant problem, "How are animals related to plants?" has received constant emphasis throughout the four periods. Each author has included the problem in every period. A partial explanation for this may be that over a period of years, the basic and fundamental relationship between plants and animals is relatively the same; hence, no change in this dominant problem.

3. Electricity—In textbooks more emphasis was given in the first two periods to the dominant problem, "How does a telephone operate?", than in the later ones. Table I indicates that the problem has been replaced by "How does a radio operate?" The change probably is influenced by new discoveries and inventions related to the improvement of radio in recent years. In like manner "How is television produced?" is rapidly coming into prominence as shown by its occurrence in three of the books for the last period. It is no longer considered important to explain the operation of a steam engine as it is gradually disappearing because of the demand for faster and more efficient modes of transportation.

4. Energy—The dominant problem, "Why is energy essential to machines?", has appeared in every text with one exception. The emphasis can be attributed to the constantly increasing number of machines depending on some kind of energy for their operation and their influence on the lives of all persons in an industrial civilization.

5. Forces of Nature—Chief emphasis is placed on forces relating to agriculture and to the airplane. This is probably due to the universal importance of farming and the rapid development of aviation during the periods 1911 to 1934. The steam engine and the automobile are given minor consideration.

6. Health—The dominant problem, "How can the span of life be increased?", has received the highest frequency possible. Both in school and out of school the emphasis upon the improvement of health during the past twenty-four years has had a very beneficial effect upon public health generally. Moreover, there is a great deal of material in the public press relating to the problem and dealing with such matters as vitamins and general preventive measures for taking care of the teeth, eyes, lungs, etc.

7. Heat—The problem relating to fires is equally important since our very existence depends on the use and control of fire.

8. Light—There is a shift of emphasis from the problem, "How is light produced?", to "How are motion pictures produced?" The reason may be the rapid development and universal appeal of motion pictures.

9. Machines — The emphasis has been shifted from the steam engine to the electric train. This may reflect a belief that the steam locomotive is gradually disappearing and that the electric train is coming into prominence. The gas engine, trolley car, and the electric train received approximately equal attention since these are modes of transportation all about equally important for man's daily use.

10. Matter—The problem, "Of what importance are building materials?", has received great emphasis. This may be because there are usually illustrative materials readily at hand.

11. Planets—The problem, "How is the earth related to the universe?", ranks high. The construction of the huge telescopes may have increased the emphasis given to this problem.

12. Plant Life—There is strong evidence to show the value of the dominant problem, "How can soil be improved for plant life?" The problem has a direct bearing upon the

preceding item in Table I, "How are plants improved?" Undoubtedly every one will agree as to the importance and significance of these problems to mankind.

13. Soils—There is strong evidence to show the value of the dominant problem, "How can soil be improved for plant life?" This dominant problem is of equal importance with the one pertaining to plant life since they are closely related.

14. Sound—The shift in emphasis from the phonograph to the sound-motion pictures came as a natural result of the universal appeal of moving pictures. This has aroused interest in the scientific principles used in making and producing sound-motion pictures, and the topic is being included in the general science textbooks of today. However, the problem, "How do musical instruments produce sound?", has received the same frequency as "How are sound pictures produced?" It is probably related to the fact that the interest in orchestral instruments is stimulated by actual contact with instruments, and the persistent desire for intelligent information relative to musical instruments.

15. Water—The problem, "How is water used as a means of transportation?", is well distributed throughout the different periods for all books except one published by D. C. Heath and Company in the last period. The problem, "How does a water supply system operate?", appears for all periods except one, which indicates agreement with respect to this problem.

16. Weather—The two dominant problems, "How does location affect weather?" and "What does the weather bureau do?", receive almost equal attention with a rather high frequency. Both appear to be fairly constant throughout the four periods.

To summarize briefly: Old established and long familiar scientific facts, principles, or devices are receiving less attention and the newer and seemingly more important discoveries are receiving greater emphasis in recent general science textbooks.

General Recommendations

According to the data in Table I, since a dominant problem should present an essential aspect of the environment, problems in general science textbooks should keep pace with the changing conditions of our environment. It is recommended, also, that teachers supplement problems in general science textbooks by introduction of additional materials as soon as possible after new discoveries and inventions occur.

LEARNING OUTCOMES FOLLOWING SELF-DIRECTED AND FORMALLY GUIDED RESPONSES IN CONTROLLED SITUATIONS[1]

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Learning is undoubtedly a complex function; it is variable in process and outcomes, both explicit and implicit, because of the continuous interaction of individual personality with an ever-changing environment.

STATEMENT OF THE PROBLEM

This study is concerned primarily with the statistical comparison of two approaches to learning in so far as they were amenable to isolation and measurement. Specifically, the problem is to compare learning outcomes of eighth and ninth grade pupils whose responses are self-directed in given situations with the learning outcomes of the same pupils when their responses are formally guided in analogous situations. Further, to verify findings, the learning outcomes of matched groups in the two situations are likewise compared in certain instances.

GENERAL SCOPE OF THE PROBLEM

In its broader aspects, the problem is as old as diverse theories concerning the nature of learning. Rousseau[2] and Froebel[3], for example, were among those who believed that learning emanated from the child. Herbart[4], on the other hand, claimed that the skill and personality of the teacher and the control of the environment required primary emphases in the best learning situations. Dewey[5], at the beginning of the twentieth century, stressed the importance of the learner's mindful reaction to his environment: of his undergoing the effect of his action together with the physical act; of his reconstruction of experience in terms of his environmental contacts.

Apparently no experimental study has been made which is explicitly related to the problem in hand; however, Boyd Bode[6], reasoning pragmatically, has arrived at conclusions similar in purport, if not in exact wording to those indicated by the findings of this study.[7]

SOURCE OF MATERIAL USED

The experiments which comprise this investigation were carried on in a junior high school of approximately 1700 enrollment, similar in many aspects of organization to others of its classification in the city of Los Angeles, where it is located. The school is uniquely known, however, for its progressive administrative and classroom policies.[8]

The community in which the school is located is slightly privileged, and the proportion of children other than white is about two per cent. These are Japanese.

The experiments of this investigation were made possible inasmuch as the investigating teacher had assigned to her three groups of pupils, 104 in total number, of approximately equivalent mental ages. The three groups, according to grade, included thirty-four A8's, thirty-six B9's, and thirty-four A9's. Mental age means were respectively fifteen years, seven months; fifteen years, nine months; and fifteen years, nine months; presenting no statistically significant differences. The mental age range of the 104 pupils, including one or more pupils at practically every month in-

[1] This article is the synopsis of the essential procedure, findings, and conclusions of a doctoral dissertation written at the University of Southern California, 1937. The author wishes to acknowledge especially the counsel of Dr. Albert S. Raubenheimer, Dean of the College of Arts, Letters and Sciences, University of Southern California.

[2] Monroe, Paul. *A Text-Book in the History of Education.* New York: The Macmillan Company, 1930, p. 566.

[3] Findlay, Joseph J. *Foundations of Education.* New York: Henry Holt and Company, 1926, pp. 51–52.

[4] Kandel, Isaac L. *Twenty-Five Years in American Education.* New York: The Macmillan Company, 1924, pp. 158–69.

[5] Horne, Herman Harrell. *This New Education.* New York: Abingdon Press, 1931, pp. 104–7.

[6] Bode, Boyd. "Education as Growth: Some Confusions," *Progressive Education,* XIV (March, 1937), pp. 151–57.

[7] The investigation recounted in this article was completed several months prior to the publication of Dr. Bode's philosophical discourse.

[8] Thomas Starr King Junior High School, Los Angeles, California, is the school to which reference is made. The principal, Dr. Alice Ball Struthers, is widely known especially for her progressive interpretation of educational goals.

terval except for the upper extreme, extended from thirteen years and eleven months to nineteen years and zero months in all but one experiment. Mean intelligence quotients were respectively 114.27, 113.75, and 108.68; the differences 5.59 and 5.07 between respective means for the A8's and B9's, and the A9's were statistically significant, though the fact did not prove important to the findings in the present investigation.

Summary of Experimental Technique

Similarity of groups in mental age and apparent ability became a challenging cue to the experimenting teacher to investigate the responses: (1) of identical groups to two different approaches to the same learning situation, one of which encouraged self-directed responses and the other formally guided responses; (2) of similar groups to the same approach to learning situations defined respectively as in (1); and (3) of similar groups to the two differentiated approaches, defined as in (1).

Accordingly, situations were planned to differentiate specifically between, and only between, self-directed and formally guided responses in controlled situations, if, indeed, that were possible. Moreover, the subject matter content had to be the same for any two analogous situations, even though the approach to the learning activity was different, in order that final tests might be identical for pupils who had participated in either type of activity.

Learning activities, including the subject matter of learning situations, had to be brief enough to be completed in the class period. Furthermore, they could not be related to other activities carried on regularly from day to day such as the unit of work. Yet it was requisite that they be valuable in and of

Table I

Pairing of Groups for the Vocabulary Experiments*

(1) Method of Activity	(2) Pupils	(3) Group	(4) M. A. in months	(5) I. Q. Average	(6) Time in weeks between initial and final test
S	34	A8	187.65	114.27	13
S	36	B9	190.42	113.75	6
S	70	A8+B9	--------	--------	--------
F	36	B9	190.42	113.75	13
F	34	A8	187.65	114.27	6
F	70	B9+A8	--------	--------	--------
S	34	A8	187.65	114.27	13
S	34	A9	190.64	108.68	6
S	68	A8+A9	--------	--------	--------
F	34	A9	190.64	108.68	13
F	34	A8	187.65	114.27	6
F	68	A9+A8	--------	--------	--------
S	34	A8	187.65	114.27	9
S	36	B9	190.42	113.75	6
S	70	A8+B9	--------	--------	--------
F	36	B9	190.42	113.75	9
F	34	A8	187.65	114.27	6
F	70	B9+A8	--------	--------	--------
S	34	A8	187.65	114.27	9
S	34	A9	190.64	108.68	6
S	68	A8+A9	--------	--------	--------
F	34	A9	190.64	108.68	9
F	34	A8	187.65	114.27	6
F	68	A9+A8	--------	--------	--------

* This table indicates the pairing of activities and groups for the comparison of learning outcomes following predominant emphases, respectively, on pupils' self-directed and formally guided responses during the Vocabulary Experiments. "S" and "F" in Column (1) under "Method" designate the differentiated approaches to learning under investigation.

TABLE II

PAIRING OF GROUPS FOR THE READING EXPERIMENTS*

(1) Method of Activity	(2) Pupils	(3) Group	(4) M. A. in months	(5) I. Q. Average	(6) Time in weeks between study and final test
S	34	A8	187.65	114.27	15
S	36	B9	190.42	113.75	6
S	70	A8+B9	--------	--------	--------
F	36	B9	190.42	113.75	15
F	34	A8	187.65	114.27	6
F	70	B9+A8	--------	--------	--------
S	34	A8	187.65	114.27	15
S	34	A9	190.64	108.68	6
S	68	A8+A9	--------	--------	--------
F	34	A9	190.64	108.68	15
F	34	A8	187.65	114.27	6
F	68	A9+A8	--------	--------	--------
S	34	A8	187.65	114.27	9
S	34	A9	190.64	108.68	2
S	68	A8+A9	--------	--------	--------
F	34	A9	190.64	108.68	9
F	34	A8	187.65	114.27	2
F	68	A9+A8	--------	--------	--------

* This table indicates the pairing of activities and groups for the comparison of learning outcomes following predominant emphases, respectively, on pupils' self-directed and formally guided responses during the Reading Experiments. "S" and "F" in Column (1) under "Method" designate the differentiated approaches to learning under investigation.

TABLE III

PAIRING OF MATCHED GROUPS FOR THE COMPOSITION EXPERIMENTS*

(1) Method	(2) Groups	(3) Activity	(4) M. A. in months	(5) I. Q. Average	(6) Pupils
Identical	(A8, B9, A9	Pre-test	187.15	110.05	45
Identical	(A8, B, A9	Pre-test	188.15	112.15	45
					90
S	A8, B9, A9	Lesson emphasizing thought content	187.15	110.05	45
F	A8, B9, A9	Lesson emphasizing English mechanics and usage	188.15	112.15	45
					90
S	A8, B9, A9	Judging thought content in pupils' compositions	187.15	110.05	45
F	A8, B9, A9	Judging correctness of English mechanics and usage in pupils' compositions	188.15	112.15	45
					90
S	A8, B9, A9	Composition test emphasizing creative thought content	187.15	110.05	45
F	A8, B9, A9	Composition test emphasizing correctness of English mechanics and usage	188.15	112.15	45
					90

* This table indicates the parallel learning procedures in which two groups matched for mental age participated during the Composition Experiments. "S" and "F" in Column (1) designate the differentiated methods of approach to learning under investigation. Six weeks elapsed between the pre-test and the culminating creative composition.

themselves and appropriate in subject matter content for pupils of the mental level included in the experiments of this investigation.

The three activities finally chosen were: (1) learning vocabulary which individuals encountered in typical reading, (2) reading comprehension and interpretation for the specific purpose of understanding more adequately word concepts of human relationships, and (3) evaluating compositions followed by creative writing.

Inasmuch as the time interval between a given study activity and the final test seemed likely to influence the learning outcomes, three varying periods of time were arranged in the vocabulary and reading experiments. For example, thirteen weeks, nine weeks, and six weeks intervened between the pupils' initial and final tests in the vocabulary experiments.

The tables above indicate the pairing of groups and activities in keeping with the two differentiated approaches to the learning situations under investigation, the groups or grade classification, the number of pupils in each group, and the length of time which elapsed between the study activities and the final tests.

Whenever possible, a pre-test was given at the outset of the activity in order that initial scores might be available to compare with final scores, and also that pupils might know their individual errors and study more effectively.

In the vocabulary experiments, the pre-test was easily given, and the children used their corrected papers to determine their needs for study. In the reading experiments, however, the avowed purpose of the activities was to give the pupils an opportunity to understand human relationships more adequately through the printed page; therefore, it seemed unwise to have the experimental groups guess at answers to questions based on reading content which was totally unfamiliar to them. Therefore, another group of ninth grade pupils, sixty-four in number, with equivalent mental age, mean and range, were given the final reading tests without having read or studied the reading content included in the experimental activities. Their mean score served to establish the validity of the test materials as measures of the effectiveness of study activities on the final scores.

In the composition experiments, the pre-test consisted of a composition judgment test composed of sample compositions written by pupils of the eighth and ninth grades in other schools during several years previous to these experiments. Values assigned the composition samples had been determined by specially trained adults.[9]

The purpose of the experimenting teacher was to exclude herself from the learning activities except in the composition experiments. Study guides to the activities were mimeographed, and aside from an initial reading of instructions, the teacher gave no assistance, except as noted, in the composition experiments. In the latter, she did her utmost to shape the learning outcomes in the respective directions defined in the problem.

Differentiation of approach to learning in the respective activities was achieved as follows:

In the vocabulary experiments, the pupils who were encouraged to direct their own responses were told that they might learn in any manner whatsoever the words they had failed to recognize during the pre-test. A mimeographed study guide, however, suggested that persons frequently learned new meanings more thoroughly if they connected or associated them with some already familiar person, place, or thing: for example, a diagram or drawing might serve the purpose; using the word in a sentence about oneself might help; studying the context in which the word was used might be effective; learning synonyms of the word suggested in the dictionary might afford a clue.

The formally guided pupils, on the other hand, were instructed to look up the words they had not recognized during the pre-test in the dictionary, write the definitions, or meanings, and learn them.

No help was given by the teacher in either of these activities. The same final test, similar in form to the pre-test was given to pupils who had participated in both types of study activities. Identical groups were rotated between the self-directed and formally-guided approaches to learning in three such vocabulary experiments; the groups were composed of 104 pupils in the three grade classifications previously described.

In the reading experiments the "self-directed" pupils, after reading selections espe-

[9] For details of the technique used in the rating of composition values, see Huxtable, Zelma Langdon. "Criteria for Judging Thought Content in Written English," *Journal of Educational Research* (March, 1929), pp. 188–95.

cially chosen by the teacher because of human interest content, were asked in the mimeographed guide, to check statements taken from the reading contexts which they considered susceptible of, or subject to, varying interpretations. Pupils had their books open before them for this study activity. Emphasis was placed essentially on divergence of opinion during study.

The "formally guided" pupils were given the same statements from the context in their mimeographed guide, but certain key words and phrases were omitted from the context and placed out of order in lists below the respective statements to which they belonged. Pupils were asked to place the given words and phrases in the spaces left blank in a manner to reproduce the meaning intended by the author. Books were open before the pupils for this study activity.

No help was given by the teacher in either study activity. Identical groups were rotated from one approach to the other in three such reading experiments; the personnel of the groups were the same 104 pupils in the three grade classifications previously described. The same final test was given pupils who had participated in either type of study activity.

The composition experiments presented a difficult problem inasmuch as subjective rating of compositions by trained adults are known to be unreliable. In order to reduce to a minimum the effect of subjective composition ratings on the comparison of learning outcomes, two composition judgment tests, each including ten sample compositions, were compiled from the compositions of several hundred eighth and ninth grade pupils before the present experiments were undertaken. The composition samples included in the judgment tests had been rated, at least three times, on a ten-point scale by four specially trained adults. One test, Composition Judgment Test A, was used in the present experiments as a pre-test; the other, Composition Judgment Test B, as a final test. Two groups of forty-five pupils each, matched approximately for mental age participated in the composition experiments. The pupil personnel, for the most part, were the same who had participated in the vocabulary and reading experiments. One group was designated "self-directed" throughout the experiments; the other, "formally guided." The self-directed group, after the pre-test, were taught by the teacher that the original expression of thought content in written English was the chief criterion of effectiveness; the formally guided pupils were taught that correct usage, punctuation, spelling, and grammatical construction were extremely important to the effectiveness of written expression. The second and final composition judgment test was given pupils after six weeks of study on their respective emphases. A creative writing test followed the final composition judgment test, but the ratings assigned the creative expression of the experimental groups were not included in the comparison of learning outcomes considered in this investigation except as contributory evidence.

Summary of Findings

Neither of the differentiated approaches to learning, namely, the one emphasizing pupils' self-directed responses, based on the assumption that individual capacity would express itself more variably and completely in the outcomes; the other, emphasizing formal guidance of pupils' responses, based on the assumption that a more uniform restatement of authoritatively determined values would characterize the outcomes, resulted in measurable differences statistically significant in any one of twenty-four group experiments, including 804 instances of pupils' tested response.

Supplementary: Statement of Possible Applications to Educational Procedure

As soon as the absence of any statistically significant difference in self-directed and formally guided learning outcomes became evident, the experimenting teacher was much puzzled. Ultimately, however, the very equivalence of the learning outcomes became axiomatic in the solution of the problem.

For significant, undoubtedly, was the fact that pupils throughout the various experiments made certain values integral in their experience to about the same measurable extent, whether the study activities emphasized self-directed or formally guided responses. Examination of the wide range of variability in the words missed on the vocabulary pretests and remembered on the final tests indicated that pupils made integral in experience those values which they, in the nature of their several experiential backgrounds or imme-

diate interests or felt needs, had been ready to make use of despite their manifest participation in certain forms of subject matter organization. This hypothesis was borne out by the testimony of individual pupils during interviews which followed the conclusion of all the experiments. For example, one boy who had remembered the meaning of the word "immedicable," from Edwin Markham's poem, *The Man with the Hoe*, was asked why he remembered that word and forgot others. His answer was, "My mother is the head technician in the _____ _____ Hospital. Naturally, I remember any word that has anything to do with medicine. I've had Latin, too, so I thought 'can't be cured with medicine'."

Particularly significant was the fact that the experimental evidence in the present investigation substantiated Dewey's hypothesis concerning the functional nature of subject matter and method; to quote:

> Method is a statement of the way the subject matter of an experience develops most effectively and fruitfully. It is derived, accordingly, from observation of the course of experiences where there is no conscious distinction of personal attitude and manner from material dealt with.[10]

To summarize: Dewey's contention that subject matter and method cannot be dissociated in the learning process; more precisely, that method is the individual's peculiar reconstruction or recreation of subject matter to fulfill his needs or satisfy his interests, was borne out by the experimental findings of the present investigation.

Moreover, the findings pointed to the conclusions that the learning situation or activity, even though it satisfied pupils' interests or needs, contributed integrally to their experience, to the extent that their respective mental abilities and immediate mental sets permitted. (The time intervals between study activities and final tests were sufficiently long in the vocabulary and reading experiments to preclude mere memory.) The child learned because the new word or meaning fitted into his experience—hence his consequent interest or felt need.

In general, the higher the mental ability, the more completely pupils identified themselves with the new situation in terms of the measuring devices used. In the opinion of the experimenting teacher, almost every marked individual deviation from the mean gains on the respective final vocabulary tests, was traceable to the pupil's mental ability and his immediate mental set. For the pupils were quite in verbal agreement concerning their need to learn the vocabulary which they had failed to recognize in their reading, and their educational backgrounds were not widely dissimilar. The essential problems which confronted the learner were then: (1) his mental adequacy to learn several new words, and (2) his dispositional willingness to set aside conflicting interests and to meet his apparent needs with singleness of purpose.

The effect of the short time intervals between study activities and final tests on learning outcomes was negligible, apparently. Conclusions on this point in the present investigation were not altogether incontrovertible because the subject matter on which the two approaches to learning were based was changed with each change in length of time interval between initial and final tests. Nevertheless, taking as a case in point, the practical equivalence in the mean scores of 104 pupils on Vocabulary Pre-Tests A and B: 14.87 words on the former, and 15.23 words on the latter; and the exact equivalence, 4.17 words, as it happened, of the mean gains of the same 104 pupils on Vocabulary Final Tests A and B, despite the fact that thirteen weeks intervened between pre-test and final test for Activity A and only nine weeks for Activity B, and the phenomenon does not appear fortuitous.

Comparison of gains made by the "control" and experimental reading groups implied a similar significant conclusion: namely, that learning is by no means an accident. The organism must be ready to make the new value an integral part of its experience. If such is the case, the results are relatively permanent, certainly within the time limits encompassed by the present investigation.

The learning outcomes signified, as it were, that each individual's experience was his created body of subject matter, his reference library from which his behavior issued as he came in contact with his environment in the learning and test situations.

It followed, therefore, hypothetically, that learning was predominantly creative to the extent that the individual reconstructed any

[10] John Dewey. *Democracy and Education*. New York: The Macmillan Company, 1922, p. 201.

value to become an integral part of his experience; specifically, to the end that he recreated the value to fulfill his peculiar interest or satisfy his peculiar need in experience. Moreover, as the pupils were reconstructing values under any circumstances during the learning process, they frequently did not distinguish between values which they had derived directly from authoritative sources, particularly after a few weeks had elapsed, and values which they had come to realize indirectly through the exercise of their own creative or inventive mental processes. The new values influenced the learning outcomes, despite extrinsic learning devices to which the learner had been subjected, precisely because they fulfilled unique functions in individual experience.

Similarity of learning outcomes throughout the experiments, whether the approach to learning emphasized self-directed or formally guided pupil responses, indicated that superior learning results were attributable to some other factor or factors than those specifically investigated. Inspirational leadership, direct or indirect in its manifestation, inherent in personality or environmental manipulation may be the answer. For leadership undoubtedly inspires or arouses interest and awakens individuals to the recognition of their needs.

Statement of Problems for Further Investigation

Undoubtedly, one of the greatest needs of education today is some means of testing or proving the effects of interest and felt need upon learning outcomes. Pupils with the same measurable mental equipment learn different subjects in very different ways and in very different amounts, apparently. Interest and felt need are accorded the praise or the blame, as the case may be. Yet no one would venture to estimate the extent of the effect of interest and felt need in any given instance. If the classroom teacher had this knowledge at her disposal, teaching methods would probably be revolutionized with little supervisory persuasion.

Experimentation is needed to ascertain the extent to which interest in and felt need for the mastery of skills and subject matter influence the development of "intangible" behavior values.

Moreover, a definite need exists for experimentation which will determine the specificity of education in "intangible" behavior values. Does emphasis upon honesty, fair play, integrity of personality, initiative, industry, or responsibility result in superior individual and social consciousness at all times, or at certain times, or no more often than if the pupils had been left to discover these values incidentally while engaged in interesting physical and mental activities growing out of the mastery of skills and subject matter? Or, is the answer similar to the one which has been discovered in this investigation, namely, that authoritative guidance or planned specificity in instruction may function as effectually as self-direction if pupils feel the need to reconstruct behavior values in their experience?

ANALYSIS OF LEADERS AMONG HIGH-SCHOOL SENIORS

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INTRODUCTION

Literature on the subject of leadership and leader qualities may be of two kinds. The older studies are philosophical treatises; occasionally, a modern piece of work follows this same method wherein the writer describes those characteristics which, in his opinion, have made leaders of certain individuals. Usually such descriptions are built around persons of such outstanding renown that their designation as leaders need not be questioned. This sort of analysis has its place in inspirational literature, but recently it has been replaced to a great extent by studies which may be grouped, in general, as statistical analyses. In this type of study, so-called leaders are compared with other members of their groups; the quantitative measures of various qualities are used as bases for the comparison. Studies of the latter type may be less helpful to would-be leaders seeking for inspiration, but they come nearer to valid analyses of the qualifications observed in leaders.

Most of the statistical studies of leadership use either one or both of two methods. After measures are secured for the entire group in specific characteristics, these scores are correlated with a quantitative measure of leadership. The correlation coefficient, even if high, does not mean necessarily that the two qualities are causally related. They may be interrelated but caused by an entirely different and unmeasured quality. As with other studies using the correlational method, there is the temptation to place too much faith in the relationship found. The procedure is valuable, however, in a more or less theoretical discussion of the relationship between various traits, as intelligence, social ability, persistence, etc., and leadership as measured in particular studies. The fallacy lies in the fact that the measure of leadership is not always valid and even when validated for a particular group or a particular type of activity it may not be valid for generalizations regarding leadership as a general trait.

A second method used sometimes in conjunction with the first, and sometimes alone, is that of critical ratios. After measures are secured for leaders and their group members in the trait or traits to be studied in relation to leadership, the difference between the leaders and the non-leaders is found by the standard error of the difference in the means, usually referred to as the critical ratio. This method gives a figure which is interpreted to indicate the probability that a difference between leaders and non-leaders will be found favoring the same (leaders or non-leaders) as is favored in the particular study, were other subjects examined in the same traits. For example, if leaders were found to be more intelligent than non-leaders and the critical ratio were sufficiently high, the investigator would conclude that if other samplings of similar populations were to be examined, a similar difference would be found favoring the intelligence of the leaders. This method variously applied is commonly used in trait studies such as those analyzing leadership. Provided the traits are validly measured, this procedure serves to answer the question as to differences (in direction but not in amount) between groups of leaders and non-leaders.

Two major theoretical problems have evolved from the use of the statistical method in leadership studies. The first is the definition of leaders. The second has to do with the relative generality of leadership qualities.

Should the designation of "leader" be assigned to those persons who hold positions in particular groups in any study? In attempting to answer that question, we could delve into a philosophical discussion of the meaning of the word leader, or we could show by statistics that the office-holders in a group are leaders because they may be differentiated from the other members of the group in certain qualities which are essential to leaders. This is the difficult proposition, to determine which characteristics are essential to leaders. For example, a football captain may excel all team members in muscular strength; does this make the football captain a leader, or is muscular strength an unimportant trait for leaders? The football captain may or may not possess other qualities more essential to leaders. Muscular strength may have no relationship to leadership except in football and

allied activities. If that is so, then muscular strength is not an essential quality of leaders, except of leaders in athletics. Unless the football captain differs from the team members in other qualities which are more essential to leaders in general he should not be termed a leader but rather a team member in the position of group head.

Is leadership specific to the situation and the group or a general trait which operates in many different kinds of situations? Possibly, leadership may be composed of general and specific traits; certainly the ability to get along with people is a general characteristic which would be necessary in any leader regardless of the situation, while expertness in the particular activity may be a specific quality also necessary. Some football captains may be elected to their position of group-head for reasons having to do primarily with leadership qualities and only secondarily with athletic prowess; other captains may gain their positions thru athletic ability primarily and be lacking in leadership qualities. The fact that an individual is a football captain may not indubitably put him in the leader class. The point is debatable; no evidence is at hand to give weight to either possibility. At any rate, any investigation of leadership involving a single activity or activities of several specific types should take into consideration that the conclusions may possibly apply only to group-heads in activities of similar types. This limitation must be put upon all studies unless leadership is proved to be a general trait.

Review of Literature

A brief mention of a few of the recent studies on leadership may indicate the methods generally used and the conclusions reached. Crawford found that leaders receive higher school marks than non-leaders.[1] Wetzel's high-school leaders are more able readers than the average of the school.[2] From 1374 college students in 58 groups, McCuen found that the leaders scored slightly higher on Thorndike's Intelligence Examination than the members of their groups; and the conclusion from the study is that leaders are generally more intelligent than the average of their groups but not too intelligent so that they become detached from the group.[3] Bellingrath found little difference between leaders and non-leaders in age, and in introversion-extroversion; but in intelligence, school marks, and socio-economic status, leaders were found to be slightly superior to non-leaders. None of the correlations was significant.[4]

Nutting gave seventh- and eighth-grade gymnasium girls an opportunity to choose leaders and vote for popularity. In intelligence, 40% of the team captains surpassed the median of the class; 55% of the team captains received scholarship marks above the class median; and 80% of the team captains surpassed the median class popularity. Nutting also correlated the ranking for captaincy with popularity, age, intelligence, weight-height index, and scholarship. The highest median correlation was with intelligence, .90; the median correlation with popularity was .60.[5]

Garrison used the correlational method exclusively in his study of high-school leaders. Leadership was correlated with scholarship, age, height, weight, and father's occupation. Age was negatively correlated with leadership and scholarship positively; these were the only significant relationships found.[6]

Brown, also, found a slight age difference among leaders and non-leaders, the leaders being somewhat younger than the non-leaders. The leaders in Brown's study were superior to non-leaders in socio-economic background as measured by occupational status of parents, in scholarship, and in intelligence. Sex differences were found also in this study. Differences among leaders and non-leaders were more apparent among girls than among boys in age, intelligence and scholarship. This suggests that these characteristics are more closely related to leadership among girls than among boys.[7]

Partridge discovered differences between leaders chosen by vote of the members of a camp of adolescent boys and the total camp group—differences which are larger than were

[1] Crawford, C. E. "The Effect of Participation in Extra-classroom Activities on the Scholarship of High-school Pupils." Unpublished Master's Thesis. University of Illinois. 1929.

[2] Wetzel, W. A. "Characteristics of Pupil Leaders." *School Review*. 40:532–4. 1934.

[3] McCuen, T. L. "Leadership and Intelligence." *Education*. 50:89. 1929.

[4] Bellingrath, G. C. *Qualities Associated with Leadership in the Extra-curricular Activities of the High School*. Contribution to Education No. 399. Teachers College, Columbia University New York. 1930.

[5] Nutting, L. R. "Some Characteristics of Leadership." *School and Society*. 18:387–90. 1923.

[6] Garrison, K. G. "A Study of Some Factors Related to Leadership in High School." *Peabody Journal of Education*. 11:11–17. 1933.

[7] Brown, Marion. *Leadership Among High-School Pupils*. Contributions to Education No. 559. Teachers College, Columbia University, New York. 1933.

found in the other studies above. Some of Partridge's conclusions, however, contradict the findings of the studies already mentioned. For example, several investigators, including Brown, found that leaders average younger in chronological age than non-leaders; Partridge found that the ten most popular leaders average more than twenty months older than the average for the total group. The contradiction may be a matter of method or of definition of leader. By the correlational method, Partridge shows that leadership is positively correlated with intelligence, age, height, weight, appearance, dependability, athletic ability, intelligence ratings, scout rank and tenure. By critical ratios, Partridge found that in the camp group and in the troop group, age, intelligence, height, weight, scout rank, and possibly scout tenure are characteristics which differentiate between the leaders and the total groups.[8]

In many of the above studies, leaders, so-called, were segregated by means of the votes of the members of the total group. This procedure is open to question. Is any group of high-school or college students capable of choosing leaders on the basis of leadership qualities without the influence of the popularity factor? It does not seem unfair to discount the conclusions from any study in which the validity of the leader-group has been assumed on such an unreliable basis.

Very few of the studies made use of an objective measure of leadership. Some of the leader-groups were formed by the inclusion of those holding offices but no uniformity obtains thruout the various studies suggesting that high-school leadership based upon offices held has been validly measured in such a way as to provide adequate and reliable comparison of the traits compared. Assuming that office holding among high-school students is a valid basis for the segregation of leaders, a means should have been found for transmuting offices into numerical scores indicative of their relative contribution to leadership. So far as was found, Yeager's study is the only one following such a procedure.

Yeager measured leadership even tho her study was not primarily concerned with leadership traits.[9] In this study a large group of high-school seniors were measured in eight qualities, namely, socio-economic status, intelligence, scholarship, leadership, attitude toward teachers, neurotic tendency, self-sufficiency, and dominance. Chronological age was also recorded. The use of the leadership score was secondary since it was only one of eight characteristics used in the attempted differentiation between high-school seniors interested in certain selected vocations with particular emphasis upon those interested in teaching. Yeager did not therefore study leadership except to obtain for each subject a leadership score for use in the comparison of groups segregated on the basis of occupational interests. The raw data were available for further study and proved applicable to a subsequent study emphasizing the leadership measures in relation to the other qualities evaluated, without regard for occupational preferences. It is the result of this latter study based upon the original data collected by Yeager that is reported herewith.

Leadership as measured by Yeager had its basis in extra-curricular offices held by high-school students thruout their four year course, but differed from the other studies reviewed above in that an objective evaluation was obtained for the various offices available in extra-curricular activities. The basis for the evaluation lay in Johnston's discussion of point systems and awards.[10] Johnston listed offices held by high-school students in extra-curricular activities. Yeager provided a numerical value for each office by obtaining judgments as to their relative importance. The judgments of twelve experts in the field of extra-curricular activities were averaged to obtain the numerical value applied to the offices held by the subjects in the Yeager study. These averages provided scores in leadership based upon an objective evaluation.

Examples of the types of offices included in the leadership scores with the value assigned to each according to the mean value given the office by the twelve experts are given below. Since deviations among judgments of the experts were small there appeared to be relatively little disagreement in the weights given the various offices by the members of the jury.

[8] Partridge, Ernest D. *Leadership Among Adolescent Boys.* Contributions to Education No. 583. Teachers College, Columbia University, New York. 1933.

[9] Yeager, Tressa C. *An Analysis of Certain Traits of Selected High-School Seniors Interested in Teaching.* Contributions to Education No. 660. Teachers College, Columbia University, New York. 1935.

[10] Johnston, Edgar G. *Point Systems and Awards.* A. S. Barnes and Co., Inc., New York. 1930.

Student council president	18.2
Chairman, standing committee	7.4
Senior class treasurer	4.6
Junior class president	7.3
Sophomore class secretary	3.2
Freshman class president	6.1
Home room president	9.2
Newspaper editor-in-chief	16.8
Business manager of newspaper	13.9
Advertising manager of annual	7.5
Inter-class debate team member	6.3
Inter-school debate team member	7.4
Lead in senior play	7.7
President boys' athletic council	7.5
School yell leader	6.2
Minor in other play, musical show	3.2

The above represents only a sampling of the 103 offices used in the leadership scores; in addition there were values assigned to captains, members and managers of the various athletic teams.[11]

Many of the offices held by students represent not leadership but prominent participation. Approximately 75% of the entire group of 783 high-school seniors had held at least one extra-curricular office thereby earning a leadership score, so-called. Those who had held no extra-curricular office in the entire four years of high school and therefor have a zero leadership score, are herein referred to as "non-leaders" to distinguish them from the ones who by right of their extra-curricular offices have some score in leadership no matter how low. The range of the leadership scores was 1 to 250, however, and this wide range suggested that not all those students having held offices were really leader-calibre. The lower leadership scores were obtained by those who had held some one or several minor offices and, while they for this reason fell into the leader group as opposed to the non-leaders, still they did not warrant the term "leader." Further study of the leadership scores was made in an attempt to refine the measurement and redefine the term.

The distribution of leadership scores, ranging from 1 to 250, was divided into quartiles. The highest fourth of leadership scores were segregated into a group called "high-grade leaders"; the lowest fourth was called "low-grade leaders"; and the middle 50% of the distribution was called "mediocre leaders." The average score in each of the eight measures was computed for each of these three groups of leaders, as well as for the total group of leaders and the non-leaders. Sexes were kept separate to avoid the possible influence of sex differences.

[11] For the complete list see Table III, page 17, Yeager, *op. cit.*

Content of Leadership Scores

Does extra-curricular office-holding by high-school students signify leadership? Study was made of the types of offices composing the scores of the high-grade leaders, the upper quarter of the distribution of the leadership scores.

In the high-grade leader group the greatest number of offices was held by a boy, forty offices over a period of four years of high school; the greatest number of offices held by any girl in the high-grade leader group was thirty-four. No girl in this group of high-grade leaders had held less than nine offices, one boy in the high-grade leader group had held only four offices, each office having been important enough to earn for him a high total leadership score. The average number of offices held by the high-grade leader boys was 14.9; by the high-grade leader girls, 16. The range was greater among the boys but there is very little difference in the averages of the two sex groups. In each sex group eleven students had held twenty or more offices.

For contrast, it should be reported that in the low-grade leader group no boy or girl had held more than four offices. Most of the positions giving these low leadership scores were in the fields of athletics or student-body offices. There were few in the field of dramatics and fewer still in journalism. Yet the highest number of offices held by any one student in the high-grade leader group was mainly in the field of journalism. Possibly leaders in journalism and dramatics are specialists.

Generality of Leadership Trait

The offices included in the leadership scores may be classified as dramatics, athletics, journalism, and student-body officers. If leadership is a specific quality, the evidence should show that these leaders specialize in one of the several fields. If leadership tends to be a general trait, these leaders then are likely to have some part of their leadership scores from several fields.

Analysis of the leadership scores of the high-grade leaders brings out the following facts: fourteen per cent of the boys and of the girls gained their leadership scores from

one field; 43% of the boys and 21% of the girls from two fields; 34% of the boys and 51% of the girls from three fields; and 8% of the boys, 14% of the girls had held offices in all four fields. Since all but 14% of the boys and girls have held offices in more than one field, the data suggest the generality of leadership among high-school students.

Further analysis of this diversification of interests in terms of the number of offices held suggests that there is greater overlapping of student-body officers and athletics leaders than of the other two fields. Journalism and dramatics are two types of activity which demand specialized abilities, but so too is athletics. The evidence from one point of view is given in the following tabulation of the number of leaders participating in various combinations of fields:

Dramatics–Journalism–Athletics–Student body officers	6 boys	9 girls
Dramatics–Journalism–Athletics	6 boys	10 girls
Dramatics–Journalism–Student body officers	17 boys	25 girls
Dramatics–Journalism	15 boys	13 girls
Dramatics–Athletics	14 boys	27 girls
Dramatics–Student body officers	28 boys	31 girls
Journalism–Athletics–Student body officers	15 boys	21 girls
Journalism–Athletics	17 boys	22 girls
Journalism–Student body officers	32 boys	26 girls
Athletics–Student body officers	41 boys	44 girls

The combination of athletics and student-body officers shows the greatest overlapping; 53% of the boys and 70% of the girls in the high-grade leader group obtained their leadership scores in these two fields. Forty-two per cent of the boys and 41% of the girls combined journalism with student-body offices. Thirty-six per cent of the boys and 49% of the girls combined dramatics with student-body offices. Obviously, the student-body officers are likely to be chosen from leaders in other fields.

It must be remembered, however, that student-body offices and athletics give more opportunity for office holding than do journalism or dramatics. There are 36 offices available in the student-body classification; over 40 in athletics; in journalism there are 20 offices available, and only seven in dramatics. It may be possible that were other offices available in the fields of dramatics and journalism, leaders would gain a greater proportion of their scores in leadership from these two fields.

Basis for Comparison of Leaders and Non-Leaders

The other qualities Yeager used in the comparison of high-school seniors interested in various selected occupations were used also in the present study; namely, socio-economic status, intelligence, scholarship, attitude toward teachers, neurotic tendency, self-sufficiency, and dominance. The development and application of these measures have been described in the original study.[12] Suffice here to mention briefly their sources.

The measure of socio-economic status was secured by the application of an adaptation of the Sims' score card.[13] Intelligence quotients were obtained by the Otis Higher Examination. Scholarship scores were found by the average of grades during the entire four years of the high-school course, numerical values having been assigned to the letter grades used in the particular school system. For a measure of attitude toward teachers Yeager constructed an attitude scale following the Thurstone method.[14] From the scores of the Bernreuter Personality Inventory measures of neurotic tendency, self-sufficiency, and dominance were obtained.[15] Since the percentile norms of Bernreuter did not fit the subjects of the Yeager study, a new set of percentiles was computed on the basis of a general experimental group of five hundred typical high-school seniors, which percentiles were substituted in the original study by Yeager. In the present study, however, raw scores from the Bernreuter Personality Inventory were used instead of percentiles from either the Yeager or the Bernreuter norms.

All subjects of the Yeager study are included in the present analysis without regard for vocational preferences or any other groupings made by Yeager in the original study.

[12] Yeager, T. C. *op. cit.* Chapter III, pp. 23.
[13] Sims, V. M. *The Measurement of Socio-Economic Status.* Public School Publishing Co., Bloomington, Ill. 1928.
[14] Yeager, T. C. *op. cit.* Chapter IV, pp. 24–41.
[15] Bernreuter, R. G. *Personality Inventory, Manual of Directions.* Stanford University Press, Stanford University, California.

Evidence of Differences Between Leaders and Non-Leaders

With regard to age, non-leaders have a median of 18 years one month; the total leader group median is 17 years eight months. This age difference of five months is large enough to indicate a reliable difference; leaders are likely to be younger than non-leaders. When each sex is considered separately, the same holds true, altho the difference among the boys is less than among the girls. Non-leader girls are, however, so variable in age that the difference in age is less significant than the smaller difference among the boys.

When the leaders are divided into the three levels of leadership, high-grade, mediocre, and low-grade, critical ratios show that non-leaders are significantly older than leaders even when the latter have low leadership scores, and the high-grade leader girls are reliably younger than the low-grade girl leaders altho the latter is not true among the boys.

Table II makes possible a comparison of leaders and non-leaders in the other seven measures. When sexes were combined, critical ratios are such that leaders prove to be higher in scholarship to such an extent that the difference found is conclusive. The difference in socio-economic status and in intel-

Table II

Comparison of Leaders and Non-Leaders

Measures	Boys		Girls		Total	
	Leaders	Non-Leaders	Leaders	Non-Leaders	Leaders	Non-Leaders
Socio-economic status:						
Mean	2.29	2.09	2.33	1.92	2.31	2.02
Sigma	1.03	1.02	1.00	.89	1.02	.97
Sigma Mean	.06	.10	.06	.10	.04	.07
Critical Ratios	1.71		3.50		3.63	
Intelligence Quotient:						
Mean	111	108	111	107	111	108
Sigma	11.7	12.4	11.3	11.5	11.5	12.1
Sigma Mean	.67	1.18	.69	1.24	.47	.86
Critical Ratios	2.28		3.24		3.78	
Scholarship:						
Mean	2.30	1.89	2.45	1.88	2.37	1.89
Sigma	.67	.54	.64	.56	.66	.54
Sigma Mean	.04	.05	.04	.06	.03	.04
Critical Ratios	6.41		7.92		9.60	
Attitude toward Teachers and the Teaching Profession:[a]						
Mean	4.63	4.90	4.51	4.55	4.57	4.75
Sigma	.96	.94	.95	.94	.95	.96
Sigma Mean	.05	.09	.06	.10	.04	.07
Critical Ratios	2.62		.34		2.25	
Neurotic Tendency:[b]						
Mean	—31.92	—11.48	10.61	20.96		
Sigma	78.92	73.10	77.40	83.06		
Sigma Mean	4.49	7.03	4.42	9.12		
Critical Ratios	2.45		1.02			
Self-sufficiency:[b]						
Mean	12.88	14.63	—11.60	—15.18		
Sigma	49.88	44.44	58.64	52.12		
Sigma Mean	2.82	4.28	3.62	5.72		
Critical Ratios	.34		.50			
Dominance:[b]						
Mean	37.76	21.30	10.00	—4.10		
Sigma	56.98	55.46	65.00	60.18		
Sigma Mean	3.23	5.34	4.01	6.61		
Critical Ratios	2.64		1.82			

[a] The lower the score the more favorable the attitude.

[b] Sex comparisons are invalid; scores of sex distributions cannot be combined into a total distribution.

ligence is high enough to be important in pointing out a tendency altho the critical ratios are not large enough to be truly significant. In these three traits, the differences between leaders and non-leaders are more marked among the girls than among the boys.

In the three measures of personality, neurotic tendency, self-sufficiency, and dominance, the differences are not reliable. It should be noted, however, that leaders are more dominating than non-leaders in each sex group while they are less neurotic and less self-sufficient.

The comparison is continued by the three-level classification of leaders: high-grade leaders being those scoring in the top quarter in leadership; low-grade leaders being those scoring in the lowest quarter in leadership; and mediocre leaders being the middle fifty per cent.

In socio-economic status, the average increases from non-leaders of each sex thru the low-grade leaders to mediocre- and high-grade leaders, suggesting a relationship between degree of leadership and socio-economic status. None of the differences are reliable among the boys and while greater among the girls they are still not quite large enough to be statistically significant.

Every comparison of the groups as to intelligence is evidence of the small influence of intelligence upon leadership: the boy mediocre-leaders are less intelligent than the low-grade leader boys who very nearly equal the high-grade leaders. Among the girls, the high-grade leaders excel the mediocre-leaders, but the latter are no better than the low-grade leader group. In each sex, however, the averages of the leader groups are higher than the average of the non-leader groups.

The comparison on the basis of scholarship shows greater differences between leaders and non-leaders than do the comparisons in other measures. As in socio-economic status, the averages progress upwards from the non-leaders, thru low-grade leaders and mediocre-leaders to the high-grade leaders. Unlike the socio-economic status scores, these differences are great enough to be significant: high-grade leaders are truly more scholarly, as measured, than low-grade leaders or non-leaders; mediocre-leaders are, especially among the girls, likely to be better students than low-grade leaders or non-leaders.

With regard to the attitude toward teachers, the average of the various groups fluctuates in a manner hardly better than chance. High-grade leaders are most favorable toward teachers, it is true; but low-grade leader boys are more favorable than mediocre-leaders, and non-leader girls are more favorable than low-grade leader girls. This lack of consistency plus the low critical ratios suggests that there is practically no relationship between leadership scores and the students' attitudes toward teachers.

High-grade leaders are less neurotic than lower-grade leaders or non-leaders, especially among the boys. Low-grade leader girls are more neurotic than non-leader girls, altho the difference is negligible. None of these differences is truly indicative of real differences in neurotic tendency.

The differences in self-sufficiency are also unimportant. The high-grade leader boys are more self-sufficient than lower grade leaders or non-leaders, but the latter are more self-sufficient than the low-grade or mediocre-leader groups of boys. Among the girls the high-grade leaders are more self-sufficient, but the non-leaders surpass the low-grade leaders.

By measure of dominance, it appears that high-grade leader boys are much more dominant than leaders of lower leadership scores or the non-leaders. The difference is large enough that a significant difference may be inferred between high-grade leader boys and non-leader boys, with a strong indication of a reliable difference between high-grade leader boys and lower grade leaders. The differences in dominance among the girls are not so large, but point in the same direction generally.

Considering these findings, it may be reasonable to conclude that leaders are better scholars, slightly more intelligent, and younger than non-leaders; that the high-grade leaders are apt to be more different in these respects from non-leaders than are the low-grade leaders. Leader girls are likely to have a higher socio-economic status than the girls who are non-leaders, but there is no such difference apparent among the boys. High-grade leader boys have a more favorable attitude toward teachers than non-leader boys but non-leader girls do not differ greatly from leader girls in their attitude toward teachers. In the personality traits measured, there is little difference in neurotic tendency and self-

sufficiency, but the leaders are more dominant than the non-leaders, especially the boys. In most traits, the differences between leaders and non-leaders are greater among the girls than among the boys.

Study of Sex Differences

In order to estimate the significance of any sex difference between leaders and non-leaders, it is necessary also to know the difference, if any, in the measures when boys are compared with girls without regard for their leadership qualities. If there is no difference in a particular measure between boys and girls in general, and no difference between the sexes in the non-leader groups, a large difference between the sexes in the leader groups may indicate a difference correlative with leadership. In such a case, the difference would be related to leadership qualities rather than to sex differences, and may show that prerequisites for leadership are different for the two sexes. On the other hand, if a difference between the sexes is found in the comparison of boys and girls in the total groups and in the non-leader groups as well as in the leader groups, the difference may be said to be mainly a sex difference having no significant bearing on leadership qualities.

Girls are consistently younger than the boys of the respective group. The difference in age between the total group of boys and the total group of girls is so large that a real sex difference in age is apparent. Among the non-leaders, the difference is small. Among the leaders as a whole, the difference is significantly large; among the high-grade leaders the difference is even greater. It would seem, then, that altho the girls of the study are younger than the boys, in general, yet the difference in age is greater among leaders than among non-leaders.

None of the differences between boys and girls shows a significant sex difference in socio-economic status. Socio-economic scores favor the boys in some comparisons and the girls in other comparisons. No conclusions may be made since all the differences are small.

Sex differences in intelligence are negligible. With the exception of the high-grade leader group, the boys excel the girls in intelligence. It is worthy of comment that the high-grade leader girls surpass the high-grade leader boys. We might conclude that intelligence counts more for girls than for boys in bringing them into the high-grade leader class.

With regard to scholarship, a fairly large yet unreliable difference favors the girls in the total group. Among the leaders also the scholarship difference favors the girls. The difference is negligible among the non-leader groups. It may be suggested that scholarship is related to leadership, but that a sex difference enters into the relationship.

No large sex differences were found among the high-grade leaders in attitude toward teachers but girls as a group and in the non-leader group had a more favorable attitude than the boys of these groups respectively. No sex comparison may be made with the scores from the Bernreuter Personality Inventory.

In summation, large sex differences, considering the group as a whole, exist in the comparison of chronological age, scholarship, and attitude toward teachers. Among the non-leader groups, no large sex differences were found except in attitude toward teachers. In the sex comparison among the total leaders, chronological age and scholarship show large differences; while the sex comparisons among the high-grade leaders show no large differences except in chronological age.

Altho few of these sex differences are sufficiently large to constitute true differences were other subjects sampled, the direction of the difference is noteworthy. In the total groups, the boys surpass the girls in socio-economic status and intelligence. Among the non-leaders, the differences favor the boys in scholarship as well as in socio-economic status and intelligence. Among the leaders, the girls surpass the boys in all measures except intelligence; and among the high-grade leaders, the girls surpass the boys in all measures, even intelligence. Does this mean that girl leaders are of better quality than boy leaders? If the differences are not general sex differences, as has been indicated, it may be that superior leadership demands more of girls than of boys.

Correlational Relationships

Since the differences already found between leaders and non-leaders are not always large enough to be indicative of true differences between high-school leaders and non-leaders if other samplings were taken from similar high-school populations, the correlational

method was used to investigate the problem from a different angle.

When sexes were combined, low correlations are found between leadership scores and the measures of other qualities. Based upon the entire group of 783 high-school seniors, the highest correlation was with scholarship, r = .32 P.E. ± .016. Other correlation coefficients were low, but the small probable errors in each case indicated that the relationship, altho slight, is not a mere matter of chance. The correlations bear out the previously reported finding that significant differences were found between leaders and non-leaders in scholarship whereas in the other measures the differences between leaders and non-leaders was found to be much smaller and less significant. The low correlations, however, are to some extent caused by the inclusion of a large number of non-leaders having zero scores, since the total number of 783 subjects were used. Sexes were combined in these correlations also.

Since the differences obtained between leaders and non-leaders by the critical ratio method reported above were more marked among girls than among boys additional correlations were computed for each sex group separately including only the leaders. That is, all leaders were included in these correlations regardless of the inferiority of the leadership score, but non-leaders were excluded. If the degree of leadership has any relationship with these qualities the correlations should be higher than those found when all non-leaders were included in the computation. Table III reveals the correlation coefficients under these varying conditions.

With the exception of the measure of attitude toward teachers, the relationship is closer among the girls than among the boys. This is supplementary evidence for the conclusions suggested above. Correlation coefficients are so low and probable errors so high, however, that only in scholarship does a relationship show which could not be due to chance. Comparison of the correlations found when the non-leaders are excluded and the sexes segregated, with correlations of the total group including non-leaders and combining sexes, indicates that non-leaders have affected the relationships, but not in any consistent manner. The coefficients of correlation between leadership and socio-economic status and intelligence quotients are higher for the total group than for the boys when non-leaders are excluded, but lower for the girls. The coefficient of correlation between leadership and scholarship and attitude toward teachers is higher when non-leaders are included.

For the same degree of leadership there is great variation in the other measures, and conversely, there is little difference in socio-economic status, intelligence, scholarship or attitude between those who have high and those who have low leadership scores. There is greater uniformity among intelligence quotients than among other measures; greater apparent differences in attitude and scholarship.

These findings point to the conclusion that altho leaders average slightly higher in the qualities measured than do non-leaders, yet among the leaders there is great variation. Greater variability was found among leaders than among non-leaders in socio-economic status and scholarship. In intelligence, leaders are slightly more homogeneous than the non-leaders. These then might not be traits which are essentials of leadership, since leaders are so variable in the measures.

Conclusions

Approximately 75 per cent of the 783 students included in the present study had held at least one office during the four years of high school. The scores based on these offices ranged from 1 to 250, with a decided skewness to the low end of the distribution. These facts indicate that office-holding is not

Table III

Correlations Between Leadership and Other Selected Measures

Measures correlated with leadership scores	r for total group, including non-leaders sexes combined	r for leaders, excluding non-leaders, sexes segregated	
		Boys	Girls
Socio-economic status	.13 ± .021	.078 ± .07	.156 ± .07
Intelligence quotient	.05 ± .023	.006 ± .08	.125 ± .07
Scholarship	.32 ± .016	.244 ± .06	.265 ± .06
Attitude toward teachers	.15 ± .020	.138 ± .07	.114 ± .08

in itself an indication of leadership. To include all 587 office-holders under the term leaders would be to confer upon many students a title logically incompatible with the spread. Therefore a distinction must be made between office-holding and leadership.

Office-holders are likely to be more intelligent, more scholarly, slightly higher in socio-economic status, more dominant yet younger than students who do not hold any offices in school affairs. Differences in these qualities have been found between students who have not held any office, those who have held very few or unimportant offices, and those who have held many offices of various kinds. All differences favor the office-holding groups and the differences increase with extent of office-holding.

When the 587 office-holders as a group are compared with those who have not held any office, the differences, even tho favoring the office-holders, are sometimes so small as to be statistically unreliable. In scholarship only is the group of office-holders significantly higher than those who have held no office or very few and minor offices. The differences in all traits measured are greater for girls than for boys suggesting that office-holding demands a higher calibre of girl than of boy.

There is a wide range in the scores of leadership, so-called, from 1 to 250. There is also great variability among office-holders in intelligence, scholarship, socio-economic status, dominance, and age. Office holders are more heterogeneous in these traits than non-office-holders. Therefore students low in some of these qualifications may become prominent in the student body. In other words, office-holders are so variable that the qualifications of high intelligence, scholarship, socio-economic status and dominance appear not to be essential to mere office-holding.

However, if leadership be defined as holding many and varied types of offices, then these characteristics are essential. Groups of students segregated by extent of office-holding increase in intelligence, scholarship, socio-economic status, and dominance as the extent of office-holding increases. Those students who were segregated into a group called high-grade leaders in this study (composed of the upper quarter of leadership scores) average significantly higher than non-office-holders and those who have had several or minor offices (the low-grade leader group in the study). Therefore the students who have held many and important offices deserve the term leaders; they are significantly more intelligent, more scholarly, higher in socio-economic status, and more dominant than students who have not held offices in school affairs.

Another question raised at the beginning of this report is the relative specificity of the trait leadership. The findings of the present study show great overlapping among the types of offices held by students, especially by students high in leadership. Fourteen per cent of the students had held offices in all four fields: dramatics, journalism, athletics, and student-body offices. Approximately three-quarters of the group had held offices in two or three of these fields; while only fourteen per cent had obtained their scores from offices held in one field only. This shows a rather normal distribution and the fact that no more than fourteen per cent of 587 students specialized in one field, whereas the other eighty-six per cent had held offices in at least two fields, indicates that some common characteristic must run thruout the group of students holding offices in several fields. This characteristic has been called leadership.

Other investigations dealing with leadership, as were reviewed in the early part of this report, often based the grouping of leaders upon office-holding in a single type of activity. It is contended that such investigations have misused the term leader; the distinctions found between office-holders in specific activities may not be applied to distinctions between leaders in general and non-leaders. Furthermore, when comparisons of office-holders and non-office-holders rests on the basis of secondary characteristics such as intelligence, scholarship, etc., the degree of leadership must be extremely high and well defined; otherwise these secondary qualities are not always a valid basis for the comparison. This has been proved by the critical ratios found in the present study in many cases comparing office-holders in general with non-office-holders. These characteristics of intelligence, socio-economic status, dominance, etc., are lines of distinction between non-office-holders and high-grade leaders, but the differentiation is not truly reliable unless the leader class is restricted to the students who hold many and varied types of offices.

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